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CONTROL OF WATERPOWER.

A hydroelectric company often finds it of great advantage to control long stretches and many falls on the same river, and all of the power streams in the area served, for both technical and business reasons.

Where a number of waterpowers are developed at separate plants on the same river, each with more or less storage area behind it, the stored water in all of the ponds above a given plant can be made available there by a suitable division of the total load between all of these plants, if they are under a single control.

On a given river, the best reservoir sites are apt to be in long, deep valleys, or in lakes, near the headwaters, and unless at least a large part of the power of the stream is under a common control, it is hard to get effective co-operation for the construction of reservoirs that will benefit all alike, as some hope to obtain the benefit without the expense.

The areas covered by some of the large hydroelectric systems are so great that the power streams crossing them have their sources far apart, in different mountains or lakes, and thus present a variety of conditions, as to periods of maximum and minimum flow, and as to facilities for storage. By the control of waterpowers on several rivers that differ in such respects, it is often practicable to match the low discharge in one with a much higher discharge in another.

Another advantage in the common control of several power streams arises where one has large storage capacity, while there is little or no storage on the others. In a case of this sort, the stored water of one river may be held back for use in one or more dry months, while the other rivers generate most of the energy during the months of ample water. To realize the above advantages it is, of course, necessary that all of the hydroelectric stations be connected to the same transmission system, as is now the common practice.

Coming to the business reasons for a single control of all the large waterpowers that may be devoted to electrical supply in the service area of a hydroelectric system, it is well known that competition between such systems tends to produce rates that are much less than reasonable, and to the financial destruction of the weaker.

With government control of rates the reasons commonly given for competition no longer exist, and both the hydroelectric companies and the public will be benefited by such a combination of waterpowers as will yield the largest amount of service.

Many of the hydroelectric companies have not been slow to

see the advantages to be derived from the control of all the waterpowers within their reach, on the same river and on different rivers. As a result, some of these companies own scores of miles of undeveloped rivers with hundreds and even thousands of feet of fall, besides enough developed waterpower to supply present needs.

Thus, one of the hydroelectric systems in Southern California, with seven developed waterpowers on four rivers, includes also about one hundred miles of the Kern River with a total fall of more than 4,000 feet and an estimated capacity of more than 77,000 horsepower. Northern California contains a hydroelectric system that includes no less than six waterpower plants with scores of miles and several thousand feet of fall along four rivers.

Waterpowers on the Hudson, Sacandagua and Schoharie rivers are united in one electric system, and have drainage areas more than one hundred miles apart, in the Catskill and the Adirondack mountains. One electric company owns water rights on the French Broad and Catawba rivers that are estimated to yield 150,000 horsepower, though less than one-half of this capacity has thus far been developed.

In Montana, the waterpowers along nearly fifty miles of the Missouri River, where the fall is 200 feet, have been developed for the three plants of a single electric system. A similar development is to be found on the Spokane River, which falls about 250 feet along the forty miles ending at Spokane, and this forty miles is controlled by an electric company that has thus far developed about one-half of this total fall. On the Muskegon River, the holdings of one electric company cover a sufficient length and fall for the development of nearly 75,000 horsepower.

Montreal is supplied with electric energy from four waterpower stations, two on the St. Lawrence, one on the Richelieu, and one on the St. Maurice River, and three of these stations are owned by the same company. Four hydroelectric plants on two rivers, all under a single ownership, develop electric energy for Manchester, N. H. Springfield, Mass., has electric service from two plants on one river, and Hartford, Conn., has like service from two plants on another. Buffalo is supplied with light and power from three hydroelectric plants at Niagara Falls, two in the United States and one in Canada, designed for an ultimate output of 215,000 electrical horsepower, which thus form the largest generating capacity in the world under a single management.

THE VALUE OF TESTING.

It is hardly realized by inventors and manufacturers who have not yet indulged in accurate and persistent testing of experimental apparatus the great degree to which saving in effort and expenditure could be extended by adopting the laboratory methods of larger organizations. It is safe to say that a large percentage of the new apparatus which has been placed on the market by small manufacturers has failed only because there has not been available the testing apparatus which would have indicated the weak point. A number of devices, excellent as a whole, have become discredited because, in the assembly, there was not available the means to determine that certain elements in the construction, although of apparent perfection when used individually, did not perform satisfactorily when used in connection with other devices.

It is not only with the inventor and manufacturer, however, that the necessary testing has been neglected. Large central stations and street railways have gone on buying without subjecting apparatus to tests other than those given by the manufacturer; and, although these are absolutely trustworthy and entirely cognizant of the guarantee which accompanies all first-class apparatus, they have not demonstrated a weakness which is often entailed due to the rigors of actual service.

The equipping of a laboratory sufficiently complete to undertake tests dealing with all the ramifications employed in actual service in electrical undertakings today would be far beyond the possibilities of all but the larger manufacturing companies, and also beyond the ordinary needs and requirements of most central-station and street-railway companies. It is true, however, and it is quite necessary, that a great deal of testing should be done by the companies themselves, and this can be carried on without very great expense on the part of these companies. Testing of an extraordinary nature, requiring apparatus which is seldom used and which can be secured only at great expense, can be done at the present time by commercial organizations which have been developed for this exclusive purpose. This service is not intended for, nor are these organizations ambitious to monopolize the testing of either the manufacturer or user of electrical apparatus. Where the parties requiring tests have no facilities whatever for testing, all their work can be properly and accurately attended to, but it would appear that the chief function of the testing organizations operated on a commercial scale is to supplement the testing which can ordinarily be carried out in fairly well-equipped laboratories with the tests which require special apparatus and which must be made frequently in order to return any profit on the investment necessary to secure it.

The value of testing on a commercial scale, although demonstrated to be great beyond the most sanguine expectations of its promoters, is not yet realized to the degree it will be when more extended use is made of the facilities of the commercial testing organizations.

THE INDEX TO VOL. LIII.

With this issue the index to Vol. LIII of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN is distributed to our readers. This index includes the issues of the *Electrical Review*, of New York, from July 4 to October 31, and of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN from November 7 to December 26. It will be remembered that the index to the issues of the *Western Electrician*, of Chicago, from July 4 to October 31, was distributed in the October 31 issue of that journal.

It is advisable that care be taken to preserve the index distributed this week, as it is not possible for the publisher to make a general distribution of extra copies.

DRAFTING IN THE SMALL CENTRAL STATION.

In a central station which is too small to afford a regular drafting organization, there is often a tendency to neglect the making and filing of proper drawings covering various changes and improvements in the system. The smaller number of officials and the greater variety of duties impressed upon individuals make it difficult to keep up with the work in the direction of accurate sketches of all noteworthy construction, and hence there is liable to come a time when new work is done more or less by rule of thumb. Without thorough planning, new engineering work is bound to cost more than it normally should, on account of the constant improvement in apparatus by the manufacturers, the alterations of dimensions in new types of equipment, and the necessity of making changes in temporary layouts.

It is therefore decidedly worth while to organize a small drafting department, even in the small station, and a company may well allow the superintendent or manager an extra man for this work. In most cases a corner of the office can be fitted up with the necessary drawing table and board, and the few simple instruments and supplies provided which will make it possible for neat and thorough work to be done within the limits of the requirements. In the smallest companies it is not unusual for the central-station manager to make his own sketches, when any are turned out, but experience shows the desirability of employing a draftsman for such work, with the all-important proviso that the new man be capable of doing other things besides drawing. There is no need of buying an elaborate drawing outfit, but provision for at least a small blue-print frame and the storage of drawings and prints, data, and special reports of a technical nature can be made with little trouble. Such a draftsman can have no better training for general central-station work than these odds and ends of technical and semi-commercial problems. He can be trained to work up operating results and statistics with the slide rule, to check up material and labor costs, accumulate data on power applications and new installations of high-efficiency lamps, and, in general, be a man of all-around usefulness. Work of this kind is excellent training for a young technical graduate, and it does not require expert ability in handling intricate designing problems. Much of the work can be done by drawing in machinery merely in outline, through the use of cardboard templates, tracing more complex equipment, if necessary, by using an incandescent lamp underneath a glass table of temporary character. The plan of numbering and indexing every sketch made is essential to the best results. For the use of the men in the field, a series of standard construction prints of a size that will fit the pocket well, is a great help, and will save money through its effect in producing symmetrical installations. A given piece of work under a given set of conditions should cost about the same amount of money one time as another, and take about the same time for completion. Every central-station superintendent who administrates a small company can find plenty of work for a draftsman capable of being utilized on tests and investigations, technical records of routine operation, and, in some cases, soliciting. The main point is not so much the employment of another man in the small company for drafting alone, as the better attention to accurate records than now obtains in many cases, combined with a certain flexibility of the organization, which results when a man is available for special duties and not bound down all the time by purely routine work.

THE TELEPHONE AND CHRISTMAS SHOPPING.

The use of the telephone in making purchases is not confined to any particular locality or season, but that some of its possibilities remain to be developed is clearly indicated by the increased application of it this year in connection with the Christmas shopping of the larger cities. In New York in particular the retail stores encouraged holiday shopping by telephone, one house having placed twenty-five instruments on every floor and issued circulars to customers advising them to order in this way. The Boston *Transcript* well says that one of the great expenses in the conduct of the retail trade is the time-cost of the clerk, which stands against the average dollar's sale. The time required to effect a sale is often a long one in proportion to the results. The customer by telephone, like the mail-order customer, knows what he wants and is ready to ask for it. Delay is minimized.

The retail establishment receiving orders by either telephone or mail may accumulate them for systematic attention during the day, at hours when other demands are less pressing, this branch of the trade affording some balance-wheel against the irregularity in the flow of patronage through the doors. The telephone thus improves the load-factor of the establishment. For the thickly-settled districts the telephone occupies a valuable place between the mail order and the personal call; it lacks the recorded exactness of a written order through the post office, but it enables business to be expedited, facilitates the immediate distribution of information, and reduces congestion within the store and on the approaching streets and car lines. With the extension of the telephone habit, this aspect of electric communication is certain to grow to large proportions.

COPPER PRODUCTION IN 1907.

According to reports just issued by the United States Geological Survey, the output of copper, from the record production of 1906, shows a decrease of 48,809,191 pounds, or 5.3 per cent. The production in 1906 was 917,805,682 pounds, according to reports returned by the smelters of the country to the Survey. The smelter output chosen by the Survey as representative of the copper output of the country is made up of the production of blister copper and of furnace-refined, or so-called ingot copper of Michigan, plus the Michigan copper cast into ingots for electrolysis. It does not include the product of any additional distinctly refining process.

Based on reports collected by the field agents of the Survey from all mining companies in the country which produced copper during the year, the output was 847,151,015 pounds. This is 2.5 per cent less than the product of the smelters for the same period.

A Giant Chimney.

The largest and highest chimney in the world has just been completed at the smelting works of the Boston & Montana Consolidated Copper and Silver Mining Company, at Great Falls, Mont., for the dispersal at a great height of large volumes of gases from the copper smelters, says *The Engineering Record.* It is 506 feet high above its foundation, thus overtopping considerably all other chimneys. It rises 500 feet above the grade of the surrounding district and has an internal diameter at the top of fifty feet; it has been designed to remove 4,000,000 cubic feet of gases per minute at an average temperature of 600 degrees F. Owing to the rigid requirement imposed for its construction, including unusual stability against wind pressures, ability to withstand the action of acids formed from the waste gases, and strength to carry sixty feet of additional height with but small increase of the maximum bearing pressure, both its design and construction involved features of unusual interest.

The specifications limited the maximum bearing pressure due to both static load and the wind pressure of a 125-mile gale to twenty-one tons per square foot at any section, and required the construction to be capable of resisting the acid action of the sulphur gases. This practically limited the design to a brick chimney with an acid-proof lining, and as it was specified further that it should be so designed that sixty feet of additional height can be added without raising the maximum bearing pressure above twenty-two tons per square foot, the radial brick construction with perforated blocks was selected as best adapted for securing the degree of stability required. The construction was intrusted to the Alphons Custodis Chimney Construction Company of New York city.

New York Metropolitan Traction Reorganization.

The joint committee headed by John W. Castles, which represents the several committees of security holders of the New York city Metropolitan traction system for the purpose of formulating a plan of reorganization, has retained G. E. Tripp and the firm of Stone & Webster to collect data upon which to formulate such a plan. It is the purpose of the committee, it is stated, to obtain the full information regarding the earning capacity of the several parts of the Metropolitan system with a view of determining along what lines the reorganization should be conducted.

After Lighting Companies.

The Public Service Commission of the First District, state of New York, directed its counsel on December 18 to bring suit for penalties and forfeitures against five light and power companies for failure to file reports asked for. The Commission asked for the reports for the last six months of 1907, and stipulated in the order that they should be filed by November 30 of this year.

The Ball Electric Illuminating Company, the East River Gas Company, the Equity Gas Company, the Long Acre Electric Light and Power Company, and the Richmond Light and Railroad Company failed to obey the order. The penalty for disobedience under the law is a fine of not more than $5,000 a day. The Commission recently ordered similar suits brought against several of the traction companies for a similar failure to obey an order.

The Commission also adopted an order giving the Long Island Railroad ten days in which to reply to the complaint of M. H. Fishburn, who alleged that the company is charging excess fare on its line between Jamaica and the Flatbush Station. The complainant asserts that the ticket office is not open when he takes the train at Morris Park for Flatbush, and that the train conductor collects twenty cents, giving him a rebate check for ten cents.

The Chicago Electric Club.

The Chicago Electric Club has been holding a series of very successful midday luncheon meetings at its headquarters in the Chicago Automobile Club. On December 9, Peter Junkersfeld, of the Commonwealth Edison Company, delivered an address on "Recent Developments in the Edison Plant." On December 16, Philip Fisher, sales manager of the Condit Electrical Manufacturing Company, spoke on "Entertainment as a Feature in Securing Business." On December 23, the subject for the address was "Unfair Competition," by Luther L. Miller, member of the Chicago Bar. On December 30, the address will be delivered by Paul P. Bird, chief smoke inspector for the city of Chicago, on "The Problems Involved in the Smoke Inspection Service."

Columbia University Engineering Society.

At the December meeting of the Electrical Engineering Society of Columbia University held in New York city on December 16, C. F. Scott, of the Westinghouse Electric and Manufacturing Company, lectured on "Power Transmission." The speaker presented the limitations found in the development of various apparatus employed in the transmission of electric power and called attention to the fact that at one time the weak link of the chain lay in the generator, later in the switchboard, and again in the matter of insulation.

Car for Testing Rail Bonds.

A test car for locating faulty rail bonds which is now being used in Vienna, is described by *The Electrician,* London. The equipment consists of a direct-current motor-generator, which transforms the trolley voltage of 500 volts down to five volts, the full-load current at this voltage being 200 to 300 amperes. The poles of the machine are connected, through the axles, which are insulated from each other, to two points on the rail about seven feet apart. The voltage drop on a rail length of three feet is then measured by special contact.

High-Pressure Fire System for Chicago.

Milton J. Foreman, chairman of the Chicago City Council committee on local transportation, announces that plans for a high-pressure fire service, modeled after New York city's system of high-pressure mains, supplied by motor-driven centrifugal pumps, are being rapidly matured. The citizens' joint committee, Thomas R. Hall, chairman, and William Marshall Ellis, secretary, approves Mayor Busse's position that the cost of installation of high-pressure mains be met by special assessment of beneficiaries, and also that the system be installed without waiting for subway construction.

Operation of the Gary Steel Works Begun.

On December 21 active operation of the great steel works at Gary, Ind., was begun by starting the fire in blast furnace No. 12. These works have been building for several years, and when fully completed are to give employment to an aggregate of 25,000 to 30,000 men. Aside from the great size of the plant, it is noted for the very advanced methods to be employed in all departments of steel making, prominent among which is the most extensive use of electrical drive of heavy machinery that has ever been made in the iron and steel industry. Illustrated descriptions of the equipment of the works appeared in the ELECTRICAL REVIEW of October 17 and the WESTERN ELECTRICIAN of October 3, 1908.

Dr. Steinmetz Lectures on "Light and Illumination."

An audience of nearly 500 assembled in Fullerton Hall, Art Institute, Chicago, on the evening of December 17, to listen to an address by Dr. Charles P. Steinmetz. The meeting was held under the auspices of the Chicago Section of the American Institute of Electrical Engineers. President Louis A. Ferguson introduced the speaker, who lectured on "Light and Illumination." Although the address was on the same subject as that made by Dr. Steinmetz in New York a week earlier, which was reported in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of last week, a great many features were dwelt on which had not been brought out in the earlier lecture.

The first part of the address was devoted to a discussion of the development and properties of illuminants, particularly the various types of electric lamps. In the second part, consideration was given to the physiological requirements necessary for good illumination. Throughout the problems of producing and utilizing artificial light effectively were looked at from the speaker's characteristic broad point of view.

Throughout the history of illuminants light has always been produced through the agency of heat. It is becoming generally understood that efficiency of light production increases with increase of temperature. The efficiency is still very low, as at best about ninety per cent of the energy is converted into heat. In electric lamps we can produce light either by sending current through the conductor, as in incandescent lamps, or by formiug an arc, i. e., where vapor is the conductor. The latter is the earlier method, although the former seems simpler. The arc lamps were devised over a century ago.

Dr. Steinmetz then traced the general history of incandescent lamps. Carbon is a most refractory substance and stands the highest temperature; therefore it seems best adapted for filaments. The trouble with carbon, however, is that it vaporizes, like all substances more or less, at much below its boiling point. The condensation of the carbon on the inside of the globe (blackening) limits its value. Hence, it can be run up to a temperature of but 1,500 degrees C., or about 2,000 below the boiling point.

Different substances possess the evaporative power in different degrees, as, for instance, water and gasolene, the latter having a much higher vapor tension. So carbon has a relatively high vapor tension, and, therefore, we have now returned to metal filaments. Osmium produces filaments with an efficiency of about one-and-one-half watts per candlepower, but this metal is so rare that its demand for this purpose shortly doubled its price. Tantalum was then tried with fairly good results, and it is quite a common metal, whose vapor tension is small. Likewise with tungsten, the demand has stimulated the supply. Up to nearly its melting point, which is from 2,500 to 3,000 degrees C., its vapor tension is quite low. Once in a while a tungsten lamp blackens; this is due to imperfect vacuum.

Reverting to the improvement of carbon filaments, it should be noted that the bamboo filaments that were first made have a very high vapor tension. The squirted filaments are better in this respect and that which, after being formed, is subjected to gasolene vapor and has a coating of carbon deposited on it has a still lower vapor tension. The so-called metallized filaments are graphitized and have properties of metals to some extent. Another allotropic form of carbon may be found which will run its efficiency up to, or above that, of tungsten. The tungsten lamps have now a higher efficiency than arc lamps, except arcs of high power. The latter have their possibilities for high-intensity illumination.

In the development of the flaming arc there has been produced an illuminant independent of temperature for its efficiency. The frequency of vibrations of different vapors produces various wave-lengths, and therefore, various colors, if these lie within the visible range. The temperature of the vapor changes the color, due to affecting the various wave-lengths differently. For instance, in the mercury arc, as ordinarily used, the predominant vibration produces a bluish-green effect; if the vapor is hotter, the red rays overbalance this and produce a nearly white color; if the vapor is still hotter, a pinkish-red becomes prominent. The metals whose vapors are highly luminescent are mercury, used in the mercury-vapor arc, calcium, used in the flaming arc, and titanium, used in the magnetite arc.

Our hope for higher efficiency in electric illuminants lies, on the one hand, in finding other luminescent bodies or in improving those named, and, on the other hand, it lies in improving the carbon filament, so that we can use it to nearer its boiling point without vaporization, probably in another allotropic form.

However, we want not merely light but rather illumination. The first is the raw material; what we need is the flux of light properly distributed. In some places we desire uniform illumination, as in schoolrooms and on streets; again, we may want concentrated illumination, as on working surfaces for sewing or reading, or mixed illumination with low intensity for general lighting and higher intensity for the special field of vision. The important thing is not the amount of light falling on the illuminated object, but the effective physiological result.

Dr. Steinmetz dwelt at length on the requirements of the eye for good vision. For high brilliancy the eye adapts itself when the pupil contracts to reduce the amount of light admitted, especially if in the direct line of vision. This has led to the development of indirect illumination, to raising direct lights out of the line of sight and to reducing the intrinsic brilliancy. The fatigue of the eye is an important factor to be considered. Excessive illumination is always tiresome. Therefore, we should cut out the excess light. However, high intensity is not necessarily injurious, since the eye is accustomed to the great brightness of daylight, which is hundreds of times that produced by our ordinary illuminants. It will be found that a combined local concentrated and a low general illumination is the best, as it gives a quiet, homelike effect.

The sensitiveness of the eye varies for different colors at different intensities. The white arc is good for low intensity lighting. The flaming arc is not adapted for this, but is good for high intensities where striking effects are wanted. Yellowish light tones down differences in color. Blue or green light makes them more marked. Differences in color and brightness really afford effective means of vision. Shadows are necessary for perfect vision. Diffused or uniform illumination is consequently flat and unsatisfactory. The open arc lamp is the opposite extreme; its shadows are too sharp and intense. In some cases directed lighting is more necessary. In others, diffused lighting. Every case requires a most careful balance between the two types. The proper illumination is, therefore, much more difficult than that of the mere physical production of light flux. Photometric results are misleading, as they give no indication of the physiological stimulation that will be produced in the eye.

Copper Production in 1907.

The production of copper in the United States in 1907, according to reports returned by the smelters of the country to the United States Geological Survey, amounted to 868,996,491 pounds. The production in 1906, compiled on the same basis, was 917,805,682 pounds, and that of 1905 was 888,784,267 pounds. From the record production of 1906 the output for 1907 shows a decrease of 48,809,191 pounds, or 5.3 per cent. This is the largest actual decrease ever recorded, and is the largest relative decrease since 1886, when the percentage of decrease was 5.5. In 1907, for the first time since 1901, the production was smaller than that of the preceding year, and for the first time since 1872 the production was smaller than for the second preceding year.

The smelter output chosen by the Survey as representative of the copper output of the country is made up of the production of blister copper and of furnace-refined or so-called "ingot copper" of Michigan plus the Michigan copper cast into anodes for electrolysis. It thus consists of the final product of the distinctly smelting operations, and does not include the product of any additional distinctly refining process. The figures of smelter production for 1907 are based on direct returns made confidentially to the Geological Survey by all but one of the known smelting companies that handled United States ores, concentrates, or mattes, in 1907.

The quantity of copper given as the output of the mines of the United States in 1907, based on reports collected by field agents of the Geological Survey from all mining companies in the country which produced copper during the year, was 847,151,015 pounds, a quantity 2.5 per cent less than the product of the smelters for the same period. By far the greater portion of the mines' output is treated directly in smelters owned by, or having some connection with, the mining companies, and this large part of the mine production is reported on practically the same basis as the smelter production. But many of the mine returns are based on the actual or estimated recovery from the ore shipped from the mines during the year, whereas the smelter returns indicate the quantity of copper actually turned out at the reduction works in that period. In a state like Montana, therefore, operation of the smelters at full capacity for a few days after the mines had begun to reduce shipments would account for a distinct excess in smelter output over that reported from the mines. This fact—that when curtailment of production had once been decided on, the mines were able to execute the plan more promptly than the smelters—is responsible for the greater part of the difference between mine and smelter production of copper in 1907. In 1906, when mine and smelter production were conducted at practically the same rate, returns from the two sources were in very close correspondence, the mine output being only 0.9 per cent less than the production of the smelters. A second cause of the difference in favor of the smelter figures is the fact that the smelters recover more copper than the mines are paid for. The difference on this account is smaller than that due to other causes, but it is especially important in states like Colorado, where the greater part of the production is from custom ores generally low in copper.

During 1907 copper was produced in twenty-one states and territories, the production of the principal ones being shown in the following table:

State or Territory.	Smelter Returns.		Mine Returns. Pounds.
	Percentage of Total.	Pounds.	
Arizona	29.55	256,778,437	254,879,489
Montana.....	25.81	224,263,789	220,108,792
Michigan....	25.22	219,131,503	217,767,232
Utah.....	7.64	66,418,370	64,256,884
California....	3.88	33,696,602	28,528,020
Tennessee	2.24	19,745,119	18,893,115

These data are abstracted from an advance chapter on the production of copper in 1907, prepared for the annual report of the Geological Survey on the "Mineral Resources of the United States, Calendar Year 1907."

Electrical Equipment of the Singer Tower.

At the 281st meeting of the New York Electrical Society, held in the Singer Building, December 16, Charles G. Armstrong, consulting engineer, addressed the members.

Tower buildings, similar to the Singer, were only made possible by new devices for vertical transportation, said the speaker. The latest device, that used in the Singer tower, is simply an adaptation of the manual hoist, which is the earliest passenger elevator on record. It was found in the convent of St. Catherine on Mt. Sinai, about the sixth century.

Men and material have for many years been hoisted out of mines thousands of feet deep, but the power was applied at the surface of the earth. The first building hoists, or lifts, had their power applied in the basement, because steam was the only available motive power. The introduction of electricity, however, enabled the use of the hoist referred to, which can be placed at the top and makes the system of vertical transportation applicable to any possible height of building.

Mr. Armstrong then described his plan for exterior lighting of the Singer Building, by means of thirty searchlights or projectors, each eighteen inches in diameter. The architectural details and the color scheme of the tower are brought out in an effective manner by this flood of light.

A large number of stereopticon slides were shown, illustrating details of the construction of the building from foundation to flagpole.

The members of the society were greatly interested in the examination of the mechanical plant established in the Singer Building. This is considered one of the most modern and effective for its purpose in the world.

There were over 400 members present, and, notwithstanding the liberal provision of souvenirs made by the Singer Manufacturing Company, many of the visitors had to go away unsupplied. The company, however, will be pleased to send one of these interesting mementoes of the occasion to any member, on application to the company's office, 149 Broadway.

Through the courtesy of the Singer company, the members were divided into parties of thirty, with a guide for each party, and a tour of inspection of the entire building was made. Especial attention was called to the engine room, the main switchboard, the special plant of motor-generators for low-voltage circuits (fifteen volts), the vacuum-cleaning plant, the elevator plant and controlling, dispatching and signaling apparatus, and the searchlight equipment for night illumination of the building. A beautiful view was obtained from the tower. The entire inspection tour occupied about two hours' time.

British Post Office Wireless.

The first Post Office wireless station in England was opened by Postmaster-General Buxton on December 11. It is situated at Bolthead, on the Devonshire coast, and is intended primarily for communication with ships at sea.

Mr. Buxton, in a speech at the opening, intimated that a series of similar offices would be scattered throughout the United Kingdom.

Traffic on the Hudson & Manhattan.

Traffic over the completed section of the Hudson & Manhattan Railroad Company's tunnels, from the Lackawanna station in Hoboken, to Sixth Avenue and Twenty-third Street, Manhattan, has shown a monthly increase of approximately 150,000. In other words, the increase in the average daily travel in November was about 5,000 over the daily average in October, and that month showed the same relative increase over September. While the company will not publish any official figures on actual traffic, says the *Wall Street Journal,* it is conservatively estimated that the company is at present handling passengers at the rate of 20,000,000 a year. Officials of the company estimate that about seventy per cent of the traffic between the Lackawanna terminals and Manhattan is carried through the tunnels.

This section has now been in operation for a period of almost nine months, and the results that have been secured have far exceeded the previous expectations and have caused hearty optimism toward the results that will be obtained when the whole system is completed and in operation. That it meets the demands and requirements of the travel is being demonstrated thoroughly by the workings of this section, and the management feels little doubt but that the system will become the most important mouthpiece in the transportation to and from Manhattan of the four systems, the Pennsylvania, the Erie, the Lackawanna and the New Jersey Central, with its affiliated systems, the Reading and the Baltimore & Ohio. In addition, the interurban travel between the points is expected to be heavy.

The lower tunnels between the Pennsylvania terminal at Montgomery Street, Jersey City, and the Hudson Terminal buildings at Church, Cortland and Fulton Streets, Manhattan, will be completed and in operation by July 1 next, and will really constitute the main avenue of the system's traffic. Work on these sections has been pushed steadily, and the tunnel to Cortland Street will probably be broken through by March 1 next, but the other tube entering under Fulton Street is not so far advanced. The cutting on these tunnels averages twelve feet per day.

The transverse section on the Jersey side connecting the Pennsylvania, the Erie and the Lackawanna terminals will also be completed and in operation by July 1 next, so that the complete circuit will be in operation by that date. Plans have now been made up for the extension from the Pennsylvania Station to the Communipaw Station of the New Jersey Central, which is also the New York terminal of the Reading and Baltimore & Ohio systems.

It is estimated by officials of the Hudson Companies that the recent sale of $5,000,000 six per cent gold notes by that company, in addition to other assets already in hand, will supply sufficient funds to cover the completion of the system, and that no further financing will be required. The Hudson Companies is the constructing factor of the tunnels, having financed and built them, taking in payment $50,000,000 of the four-and-one-half per cent convertible bonds, in addition to stock of the Hudson & Manhattan Railroad Company, which is the operating company. The latter company has outstanding $5,250,000 five per cent non-cumulative preferred and $40,000,000 common stock.

Electrical Preparations for the Alaska-Yukon-Pacific Exposition at Seattle.

After expending in lump sums $910,000 for new cars, $600,000 for new trackage and $275,000 for motor-generators, transformers, high-tension transmission lines, lighting circuits, etc., the Seattle (Wash.) Electric Company, which controls the local street-car and lighting systems, will doubtless make a record in handling the traffic and lighting of the forthcoming Alaska-Yukon-Pacific Exposition. The improvements, new lines, and new power facilities which the company is installing preparatory to the 1909 fair mark a new era in street-railway improvement in the Northwest, and at the close of the exposition Seattle will be equipped with the most efficient service in the history of the city. The present expenditures will leave the car system in excellent shape after the exposition, and will insure prompt and comfortable handling of the crowds at the fair.

Four lines will tap the exposition grounds, two of which are now operating, with one other just completed and work on the fourth begun. Each line is five or six miles in length, and all will be double-tracked, with loop terminals at the grounds. A handsome terminal building and power substation will be installed on the grounds. The company expects to be able to deliver passengers at the grounds at the rate of twelve or fifteen thousand persons an hour, should the occasion demand.

The additional power necessary for these lines, and for lighting the exposition, will be furnished by the great water-power plant at Electron, on the Puyallup River, and by the steam plant at Gorgetown. Twenty miles of 13,000-volt transmission line connects this power with the substation on the grounds, where it will be stepped down to 2,300 volts. Two 1,000-kilowatt motor-generators will be located at this station, and two others at substations in the city. The power will be sufficient to handle cars as rapidly as they can be safely moved over the four lines.

A lump order of 140 cars, forty of which have already been delivered, is probably without precedent among western street-car systems. The cars are of the most modern type, and cost when set up at Seattle about $6,500 each. They are manufactured by the St. Louis Car Company, and each car has 150 horsepower in motors, and is capable of developing a speed of thirty miles an hour. Stone & Webster, who control the company, are making the present improvements of the car system in the nature of permanent investments. For the lighting of the exposition the same company has the contract, and is preparing a most elaborate illumination. The substation on the grounds will contain four 1,000-kilowatt transformers, with the necessary regulators and switches. The water front on Lake Washington and the terraced hillsides overlooking the lake, with the wide avenues of the exposition leading down to the shore, will be brightly lighted, and the night scene from the water promises to be effective and inspiring.

American Society of Mechanical Engineers' Meeting.

The next monthly meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies Building, on Tuesday evening, January 12. The paper, by Carl G. Barth, of Philadelphia, upon "The Transmission of Power by Leather Belting," will be illustrated by lantern slides. It will be a comprehensive summing up of the theory and practice of belting, in which conclusions are drawn from the work of Lewis, Bancroft, Bird and others, who have made experiments upon the transmission of power by belting. Valuable charts have been prepared by the author for the solution of belting problems.

Mr. Barth's data have been applied to belting in different plants for many years, giving an unusual opportunity to study the problem in great detail.

ALTERNATING CURRENTS AND THEIR APPLICATIONS.

BY EDSON R. WOLCOTT.

CHAPTER II. (PART III.)—OPERATION OF ALTERNATORS.

In the care and operation of generators certain precautions are very essential to high efficiency. It may not be out of place to incorporate here some suggestions from an instruction book issued by one of the large manufacturers of electric machinery.*

GENERAL CONSIDERATIONS.

1. Leave all switches open when the generator is not running.

2. Keep the generator clean and free from dust. With high-voltage machines a small accumulation of dust on the windings may be the cause of a serious burnout. It is advisable to use compressed air to clean the windings.

3. Small pieces of iron, such as bolts and tools, should be kept away from the generator.

4. Occasionally give the machine a thorough inspection; the higher the voltage, the more often this should be done.

5. Never run a composite-wound alternator with load unless all its brushes are in place, as an unduly high electromotive force will be generated in the open-circuited composite winding, which may puncture the insulation.

COLLECTOR RINGS AND COMMUTATOR.

Precaution should be taken to keep the collector rings clean, smooth and true. To prevent cutting, a little vaseline should be applied occasionally. The commutators of composite-wound generators should be kept smooth by the occasional use of No. 00 sandpaper. The lubricant should be applied to high-voltage generators with a piece of cloth attached to the end of a dry stick. If the commutator gets "out of true" it should be turned down. In the case of revolving-armature generators this can be done without removing the rotating part from its bearings, by the use of a special slide rest and by running the engine slowly, or the commutator may be taken off the shaft and turned down in a lathe.

BRUSHES.

Carbon or soft graphite brushes are preferable and are set perpendicular to the surface of the collecting rings. They fit closely and require almost no attention beyond an occasional renewal and casual inspection from time to time to see that they fit properly.

The copper brushes used to collect the direct current from the commutator of an alternating-current generator with a compensating winding, are arranged as shown in Fig. 57, which shows the correct method of setting the brushes on a commutator with ten segments. On different machines the brushes are set one, three or five segments apart; the operation of the commutator will be the same electrically as long as the brushes are an odd number of segments apart. The brushes nearest the field in one holder should be given a lead of about one-half a commutator segment (S/2) over its companion, while in the other holder the brush at the greatest distance from the field should have an equal load over the other brushes of its set. In the diagram, Fig. 57, the leading brushes touch the commutator at the middle segment, while the trailing brushes are just over the insulation between the segments. The

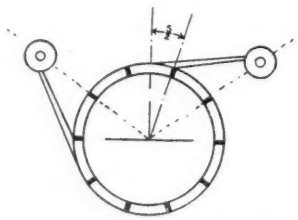


FIG. 57.—POSITION OF BRUSHES FOR COLLECTING DIRECT CURRENT FROM COMMUTATOR OF ALTERNATING-CURRENT GENERATOR.

trailing brushes should be set in position while the commutator is at rest, but the leading brushes may be changed while the machine is in operation. The compounding of a generator may be varied by shifting the brush-holder rocker, and, to a slight extent, by changing the spread of the brushes in each holder. Increasing the spread decreases the compounding, and vice versa. When the rocker arm is shifted to give the proper compounding, all brushes may be made to run sparkless by changing their spread. With a widely-varying inductive load, it is impossible to adjust composite brushes so as to obtain absolutely sparkless operation.

Sparking at the commutator may be due to any of the following causes:

1. Brushes may not be set at the point of commutation. A position can always be found where there is no appreciable sparking, and at this point the brushes should be secured.

2. Brushes may be loose or may not bear sufficiently on the commutator.

3. Brushes may be welded at the end.

4. Brushes may be spread at the end. They should present a narrow surface to the commutator.

5. Commutator may be dirty or oily, or copper dust may have collected on the insulating segments.

6. Commutator may be rough; if so, it should be smoothed off.

7. Generator may be overloaded.

BEARINGS.

The bearings should be kept clean and free from grit. They should be frequently examined to see that the oil supply is properly maintained.

A warm bearing or "hot box" may be due to any of the following causes:

1. Excessive belt tension.

2. Failure of the oil rings to revolve.

3. Rough bearing surface.

4. Improper fitting of the journal boxes.

5. Bent shaft.

6. Use of poor-grade or dirty oil.

7. End thrust, due to magnetic pull, the rotating part being "sucked" into the field because it extends beyond the field poles further at one end than at the other.

8. Bolts in the bearing cap may be too tight.

9. End thrust, due to improper leveling. A bearing may become warm because of excessive pressure exerted by the shoulder of the shaft against the side of the bearing.

10. Excessive side pull, because the rotating part is out of center.

OPENING OF FEEDER CIRCUITS.

If a line fuse blows, or a circuit-breaker opens, first open the switch corresponding to that line and then replace the fuse, or close the breaker; then close the switch. If the circuit opens again, examine the line for a short-circuit.

STARTING.

1. Examine the generator to see that it is in condition and is properly oiled.

2. Start slowly. See that the oil-rings are revolving properly.

3. Bring the machine up to speed, and turn the rheostat so that all the resistance is in the field circuit; then close the field switch.

4. Adjust the rheostat of the exciter for the normal exciting voltage; then gradually raise the alternator to its proper voltage by cutting out the resistance of its field rheostat.

5. Throw on the load.

*Westinghouse Electric and Manufacturing Company.

If the generator has a compensating winding, the brushes on the commutator must next be set at the non-sparking position. Should the current in the self-excited field cause a decrease in the voltage of the machine, it is evident that the separate and self-excited coils are opposing each other. The brushes should then be racked one segment forward or backward to reverse the current in the self-excited field.

CAUSES OF INSUFFICIENT VOLTAGE.

The following causes may prevent alternators from developing their normal electromotive force:

1. The speed of the generator may be below normal.

2. The switchboard instruments may be incorrect.

3. The voltage of the exciter may be low, because its speed is below normal, or its series field is reversed, or part of its shunt field is reversed or short-circuited.

4. The brushes of the exciter may be incorrectly set.

5. A part of the field rheostat or other unnecessary resistance may be in the field circuit.

STATIC SPARKS FROM BELTS.

In dry weather the charges of static electricity that accumulate on the belts may be of high enough potential to discharge to ground, or, if the generator is not grounded, these charges may jump to the armature or field winding and thence to ground, puncturing the insulation. By grounding the frame of the machine there is no danger to insulation.

TO SHUT DOWN.

1. Reduce the field current by means of the field rheostat.

2. Throw off the load by opening the feeder switches.

3. Open the separately excited field circuit.

4. Shut down the driving machine.

5. Clean the generator and put it in condition for the next start.

Canadian Centennial Exposition in 1912.

Western Canada is to hold a Centennial Exposition in 1912. Jefferson Clark, president of the Lewis and Clark Exposition, has been in Winnipeg, Manitoba, interesting business men in the project, upon the invitation of the Canadian Club of that city.

Electrical Trades Society of New York.

The thirteenth annual meeting of the Electrical Trades Society of New York was held at the Electrical Club, 14 Park Place, New York, on December 8. Ten accessions to membership during the year were reported. In his remarks the retiring president, R. B. Corey, after referring to the passing of the financial storm, said:

"Now what I want to bring out is the part played by this association in the saving of the day. Is there anyone who will say that there might not have been a score or more of failures had it not been for the co-operative spirit, part of which demonstrates itself in the existence of this organization? Can you not imagine the darkness and doubt which would have possessed the credit man were there no means of knowing what his fellows in the trade were doing? The most tangible indication of the soundness or weakness of customers, we maintain, is in the long run displayed to those who are close students of the association's bulletins, supplements and other records at the secretary's office. Congratulate yourselves, then, that you are members, and if you are not getting the most value for the least money and more than can be had from subscription to any mercantile agency, ask us why—addressing your inquiry to the secretary's office—and we'll soon tell you.

"At our meeting a year ago it seemed to be the consensus of opinion that customers who had always done fairly well in paying their bills and who were supposedly solvent should be given all necessary assistance in the way of leniency. In many cases our customers twelve months ago could not make collections from people who were ordinarily gilt-edged as to credit and payment. We all had to await the readjustment of credits and financial conditions, which readjustment came right along after the New Year. This leniency extended to creditors seems to have been general on the part of the electrical trade. The failures have been few in the territory of the New York Society, and, in fact, with the exception of some of the southern cities, the electrical trade has stood the strain very well indeed."

The secretary's report showed that out of claims aggregating $301,507 the society secured settlements amounting to $241,306, or eighty per cent. This is an average of $1,296 per member. The number of the separate accounts handled by the society was 2,939, of which 2,521 were settled through its instrumentality. This extra service is free, there being no charges or commissions, the annual dues covering everything.

The following directors were elected to serve for three years: John H. Dale, of the Dale Company; W. H. Roberts, of W. R. Ostrander & Co., and W. B. Wallace, of the Western Electric Company, who with the following will constitute the board of directors for 1909: W. M. Franksen, of the Sawyer-Man Company; G. F. Spencer, of I. P. Frink; A. L. Miller, of John A. Roebling's Sons' Company, and P. M. Haight, of the Sprague Electric Company. Mr. Dale was re-elected to the board of managers of the National Electrical Trades Association.

At a meeting of the directors, held immediately after this meeting of the society, the following officers were chosen for the next year: A. L. Miller, president; P. M. Haight, vice-president; W. H. Roberts, treasurer, and Franz Neilson, secretary.

Pennsylvania Railroad to Use Telephones in Dispatching.

It is understood from an official Pennsylvania Railroad source that in the near future the Pennsylvania will probably substitute telephones for the telegraph in dispatching trains and transacting other business that is now done by telegraph. The substitution, however, will depend entirely on the result of an investigation now being made of the efficiency of the telephone service on other railroads.

Several of the railroads now using the telephone system are reporting favorably on them, and say better and quicker service is obtained and is more economical. The New York division of the Pennsylvania has delegated a committee to investigate. This committee is now on a trip of investigation as far west as Chicago, where it is inquiring into the results attained by the use of telephones on the Chicago & Northwestern Railroad and other roads.

It was said that the Pennsylvania Railroad has already experimented with telephones on the line in Pennsylvania between Glen Loch and Morrisville, sixty miles, with satisfactory results.

Westinghouse Electric.

A certificate has been filed at Harrisburg of the proposed increase in the capital stock of the Westinghouse Electric and Manufacturing Company from $50,000,000 to $80,000,000, and permission to make the increase has been given.

HISTORY OF AXLE LIGHTING.[1]

BY W. L. BLISS.

(Concluded.)

The writer believes that one of the greatest contributions to the art of axle lighting was made by the inventor of the so-called outside suspension. This, as far as the writer is able to determine, was devised by Mr. Kennedy, in conjunction with certain officials of the Pennsylvania Lines West of Pittsburg. However. all of the axle-light companies have profited by the outside suspension, and certainly it has been a boon to the railroad electrician and inspector. The outside suspension made the generator accessible. It enabled a reasonably long belt to be employed, and it has probably come to stay. It was with a good deal of difficulty, however, that the mechanical officials of a great many roads were induced to sanction its application, on the grounds that it had a great many disadvantages, primary among which was that it unbalanced the truck. Theoretically, this is the fact, but practically it causes little, if any, unbalancing, especially on six-wheel trucks.

It would seem that the original method of driving the generator from the axle by means of a belt has prevailed, and that, up to the present time, all forms of gearing have been superseded and supplanted by the simpler form of belt. While the positiveness of direct gearing has its advantages and is absolutely indispensable in the case of street-railway motors, it is not so essential in axle lighting. In the case of a street-railway motor, if anything happens to the motor or to the gearing, the car is instantly brought to rest, and nothing further is done until the damage is repaired. If the mechanism is in such bad condition that it cannot be run rapidly, the car is hauled very slowly back to the repair shop. In the case of an axle generator, quite the reverse is true. If anything happens to the generator, the grinding -up process continues until nothing is left. If a hot bearing develops and the armature shaft binds, the belt forms a mechanical safety fuse between what may be regarded as an almost infinite power and a machine of decidedly finite endurance.

It would appear then, from developments up to date, that the most suitable form of mounting for an axle generator would be one which was, of course, simple and strong in its design, neat and shipshape in appearance, easily applied to the truck, and that, in its application, required no mutilation of the same. Such a mounting should permit the generator to be suspended outside and clear of the truck frame. The supporting bars of the suspension mechanism should be so disposed that the machine is completely accessible and that nothing shall stand in the way of the inspector who is examining or working upon the machine. The mounting and suspension should be such that the generator is at all times held level to prevent oil slopping, and it should be so designed that the shaft of the generator may be brought readily and accurately into parallelism with the axle of the car with a minimum amount of trouble. No better means of transmitting the power from the axle to the generator seems to have been brought forward than the rubber belt joined by means of the Crescent belt fastener. As above stated, the belt is a sort of mechanical safety fuse. Under ordinary weather conditions, it seems to be perfectly able to transmit the power. The great bugbear of snow and ice seems to have melted away before the light and warmth of experience. There are, no doubt, climates in which certain roads operate that are productive of considerable annoyance from snow and ice, but in most parts of the United States the rubber belt operating on large enough pulleys with wide enough faces and maintained at a proper tension by properly-designed tension devices, seems to fill the bill. It is cheap, safe and efficient. We have all heard more or less about driving by means of chains. The chain is necessarily more expensive than the belt. It in no wise has the great advantage of acting as a safety mechanical fuse, and it is a terrible thing when it gets loose and thrashes around. It is doubtful whether a chain can be run without lubrication, and the difficulty of enclosing it in a case that will hold oil is almost insurmountable, and who will bother to oil the individual links of a chain every few days? No one.

When it comes to machines of greater capacity than six to eight kilowatts, the rubber belt is probably inadequate as a driving mechanism. There is nothing left, apparently, but direct gearing. The writer designed, built and placed in operation a twenty-five-kilowatt axle generator on a truck of a locomotive tender. The axle was specially prepared. It was provided with a perfectly true gear seat and two polished journals, and the mounting of the machine was exactly like that employed in standard electric-railway service. Mechanically, this arrangement is perfect, or as near perfect as anything will ever be made. The gears were absolutely positive, were protected in a gear case of standard street-railway construction, and the whole machine, being large and heavy, permitted of rugged construction that withstood all the abuse and hammering that it received from the direct connection to the axle. Such a machine is perfectly suitable for head-end systems, but it cannot be operated under the ordinary conditions under which smaller axle machines are handled. So far as driving mechanisms are concerned, the outside suspension with the belt is the most suitable so far developed for small generators up to eight kilowatts capacity, and the standard street-railway mounting and drive, the only thing feasible for machines of larger capacity.

Having discussed the question of the problem of driving the axle generator, we come to the very important feature of taking care of the reversals in direction of car travel. This brings us immediately to the question of the pole changer. Pole changers can apparently be divided into the following classes: Mechanical and electrical. Under the head of mechanical pole changers we find two sub-classes, those having contacts and which momentarily break the circuit, and those which do not open the circuit, but which rely upon shifting the brushes to preserve the polarity. A mechanical pole changer is operated ordinarily from the shaft of the armature. When the armature shaft revolves in one direction the pole changer shifts certain connections so as to establish correct circuit relations corresponding to that direction of rotation, and vice versa. The brush-shifting devices depend upon rotating the brushes through as many degrees of arc as are represented by the pole pitch, plus whatever lead the designer desires to have the brushes take when commutating the current. The mechanical-switching pole changer, as distinguished from the mechanical brush-shifting pole changer, may be operated in any number of ways, all of which require considerable ingenuity to make substantial and efficient. Friction has been employed in a great many of them as the actuating force, but all friction schemes are open to the objection that a certain amount of wear goes on unless means are provided for relieving the friction, and attempts of this kind run into complication. The writer has himself preferred and developed the mechanical pole changer represented by the brush-shifting class.

[1]Abstract of a paper read before the Association of Car Lighting Engineers at the convention in Chicago on November 16.

There are a great many advantages in taking care of the polarity in this manner, and there are certain offsetting disadvantages no more numerous and no more important than the disadvantages that lie in the use of a mechanically-operated switch. There has not been a simple mechanical pole changer designed by anyone, as far as the writer is aware, and the shifting brushes and their associated mechanism are no more complicated than the simplest kind of mechanical pole changer, so that the question of mechanical pole changers cannot be said to have been settled by any standardizing, as is the case in the problem of mounting and driving.

When it comes to electrical pole changers, we find no end of schemes. The earliest American patent on an electrical pole changer appears to have been that taken out by Mr. Danals in 1889. His claim is very broad, but his device does not appear on the face of it operative. The most rational solution of an electrical pole changer, as far as the writer knows, is that offered in the patent of A. H. Whiting, in 1893. The objection to this is that it is necessary to separately excite the field of the generator in order to make the pole changer operative, and in the old Lewis system this was taken care of by a centrifugal switch, which closed and opened the field circuit of the generator directly from the batteries whenever the speed was above or below ten miles per hour, or thereabouts. The Whiting patent shows the essential elements of an electric pole changer, and while numerous variations have been made in the form of electric pole changers, they all depend upon Mr. Whiting's fundamental principle. Pole changers of the electric type necessarily are switching devices, and open and close the circuit.

There are, however, schemes by which the polarity of the generator may be preserved without the use of any switching mechanism or brush shifting whatever. They employ auxiliary machines for the purpose, and run into more or less complication and generally require the field of some machine somewhere in the system to be separately excited from the battery. We have also seen numerous attempts to solve the pole-changer problem by the use of alternators connected up with electrolytic cells and other rectifiers of one kind and another, and numerous other schemes have been proposed, but have not come into commercial use. The writer believes that the pole-changer problem will eventually be solved by the adoption of a mechanical pole changer of the shifting-brush type or a mechanical pole changer of the switching type, or an electrical pole changer of the Whiting type. It would seem that these three are the best forms to work upon and develop.

Coming now to the third part of the axle-light problem, we are confronted with the necessity of providing a means for closing and opening the generator circuit whenever the voltage of the generator shall be just above or just below that of the battery. In the early systems, a favorite means of accomplishing this result was through the instrumentality of a centrifugal switch, which would close and open the circuit at a predetermined speed of the generator. It is quite obvious that such an arrangemnt is impracticable. If the device is made thoroughly positive in its action, it will close and open the circuit mechanically without any regard to the electrical conditions that may exist in the system. In other words, it will connect a dead dynamo to a live battery or a live dynamo to a dead battery, either or both of which experiments have been repeatedly tried without success, so far as the writer is aware. There are certain experiments in railroading which, notwithstanding their fallacy has been thoroughly established, will continue to be made until the end of time. One of these experiments is the connecting of a dead generator to a live battery by those inquisitive people who want to see what will happen when the automatic switch closes, and generally find out. The other experiment is that of making two trains pass in opposite directions on a single track, which has probably been tried quite as many times as the former experiment without any successful records having been obtained. There is practically no prevention for the continuance of these experiments.

It would seem that the right way to operate an automatic switch is electrically. The switch should close at a predetermined voltage, no matter what the speed of the generator may be when this voltage is obtained. If the generator voltage at which the switch closes is equal, or approximately equal, to that of the battery at the time, no harm will result. The electrically-operated automatic switch, so far as the writer is able to ascertain, was first described by J. H. Holmes in a United States patent in 1891. He described accurately the switch that nearly all of the axle-light companies make today, consisting of some kind of magnetic circuit on which two coils or sets of coils act, one being made of fine wire and connected as a shunt to the generator and the other being made of coarse wire connected in series between the generator and the storage battery, as soon as the switch is closed.

Electricians all over the country, and, in fact, all over the world, are practically agreed upon the three problems the writer has endeavored to discuss. We all agree as to the requirements of the suspension and drive. We all agree that the polarity of the generator must be preserved, and that, whether circuit-changing or brush-shifting is employed, it must be accomplished before the speed reaches the critical or cutting-in value. And we are all agreed that the automatic switch, no matter of what form it may be or upon what principles it may act, must connect and disconnect the generator from the storage battery when the voltages bear the right relation. There are two more problems, however, connected with axle lighting upon which there is more diversity of opinion and a still greater diversity in means for accomplishment. The first is the question of regulating the generator; the second is that of maintaining constant lamp voltage.

The problem of regulating the generator depends upon the fundamental equation of the dynamo, which may be expressed as follows: $E = NCS$, where E is the electromotive force of the generator, N the number of lines of force supplied by the field and threading through the armature, C the number of conductors on the armature, and S the number of revolutions per second of the armature. In order to obtain a predetermined value for E, it is necessary that the product of NC and S be made equal to E. This gives us great and, in fact, unlimited latitude in the choice of our factors making up this expression. Confining ourselves to the axle-light problem and machines of from three to eight kilowatts capacity, the product of N and C is fixed by the size of the machine. The speed of the train at which it is desirable to have the generator become operative determines S. In ordinary axle-light work, S is generally made to correspond to between ten and twenty miles per hour, and the gear ratio between the axle pulley and that on the generator is generally made somewhere between two and three. S varies all the way from zero to some high value, and consequently E can vary from zero to a correspondingly high value. As S may be zero on account of the fact that the car must sometimes be at rest, E

must sometimes be zero, and, therefore, if light is to be at all times available, a storage battery is absolutely indispensable.

This may seem elementary, but it is well to bear these facts in mind. In order to give E certain values it is necessary to manipulate the factors NC and S in some kind of automatic manner. In spite of everything that can be done, S will vary. Various schemes have been devised whereby S is allowed to vary from zero up to a certain value, and from that point on be held constant. Such schemes are elaborate and difficult to devise, and of necessity involve an automatic change in the gear ratio after a certain value of S has been obtained. C is a fixed quantity in a given machine, and it is very difficult to devise a means whereby it can be varied, although attempts have been made to do so. The easiest factor on the right-hand side of our fundamental equation to manipulate and vary is N, and this means that it is easier to vary the strength of the field of the generator automatically than it is to vary the number of conductors on the armature or control the speed of the same. There are no systems in commercial operation in which C and S are manipulated. N may be varied in but two ways. The magnetomotive force or ampere-turns of the field coil may be varied or the reluctance of the magnetic circuit may be varied. The latter is generally difficult to vary, as the form of the magnetic circuit in a given machine is generally permanent. Here again attempts have been made to vary the form and contour of the field and thus produce changes in the reluctance of the magnetic circuit, but all such schemes require complicated mechanical devices and have not come into general use.

The simplest and most direct method of varying the quantity N is by varying the magnetomotive force or ampere turns of the field. This may be done in an almost infinite variety of ways. Two general methods have been employed. As it is necessary to weaken the field of the generator as the speed increases above the critical value which has already been described, the most ordinary way of accomplishing this is to vary the current flowing through the field coil, or what is the same thing, vary the voltage impressed upon the field coil. The other method is to oppose the magnetomotive force of the original field coil by means of current flowing through a second coil acting differentially with the first. The latter method, known as the differential dynamo, requires no external regulator, but it has the serious disadvantage that it usually results in a great deal of heat being developed inside of the machine, and it requires additional coil space to accommodate the differential winding. These two disadvantages necessitate enlarging a machine for a given output and result in very greatly diminishing the efficiency of the machine as a generator. The differential method has the further disadvantage that it does not produce the regulation in the generator that is required and may be regarded as the crudest kind of regulation. The simplicity of the differential dynamo has attracted a good many inventors and designers, but there are no differential generators in use in axle lighting at the present time, so far as the writer is aware. The method of using an external regulator of some kind for properly varying the strength of the magnetic field of the generator has been adopted by practically all builders of axle-light machinery.

The writer will discard for purposes of present discussion all regulators that employ two sets of storage batteries or those types of regulators that fail to charge all of the cells of the battery uniformly or with the same current. This excludes the double-battery systems and the end-cell schemes of generator regulation.

External generator regulators which vary the strength of the current flowing through the field winding of the generator have been built with a view to accomplishing some particular end. There are regulators in which it is attempted to maintain the generator current constant at all times above operative speed. There are others in which it is attempted to maintain the current charging the battery constant under similar circumstances. There are regulators wherein it is attempted to maintain the generator voltage constant at all speeds above the critical. We may, therefore, divide regulators into three general classes, namely, constant total-current regulators, constant battery-current regulators and constant voltage regulators. Of these three general types of regulator, the constant total-current regulator is by far the easiest to build. There are no reversals of current to provide against and no great accuracy or refinement in regulation is necessary. As long as the current maintained by one of these regulators does not vary more than ten per cent and does not at any time exceed a certain maximum, the regulator may be considered perfect so far as it goes. The total-current regulator has the advantage that at all times the generator is working at practically its maximum capacity and efficiency. It has the great disadvantage, however, that unless fairly well adjusted to its run, batteries used in connection with this regulator will become overcharged and great deterioration of the same will result. Overcharged batteries, however, are probably somewhat in the minority, the honors in this respect having been pretty well carried off by the undercharged batteries. The ill effects of overcharged batteries do not make themselves apparent immediately and are really to be discovered in the expense account later on. Undercharged batteries, on the other hand, make their presence known as a rule by a failure in the light, which is the one great thing to guard against in axle lighting. Undercharging of batteries is probably not as destructive as overcharging, but even undercharging will result in greatly reduced capacity and probably permanent injury to the batteries through sulphation and other causes. The Kennedy, the Newbold, the Moskowitz and the Everett are types of constant total-current regulators.

Battery-current regulators are rather more difficult to construct than total-current regulators, as there is always a reversal of current in the controlling winding to be considered when the battery discharges. This, however, can be provided for by very simple means and need not necessarily be a handicap upon the regulator. The battery-current regulator has the advantage that the amount of charging that will be accomplished on a certain run may be predetermined as the charging current, whether it be constant or whether an average value only be considered, is never interfered with or influenced by the lamp load. As to how much the lamps on a given run will be used is an impossible matter to determine, but with the battery-current regulator the amount of charging and discharging can be pretty accurately predetermined and the regulator set to take care of the run very nicely. The battery-current system of regulation very seldom results in overcharging the battery, and, as above mentioned, may possibly result in undercharging. The battery-current system of regulation also permits of a ready means of lamp regulation without complicating the structure of the apparatus to any great extent. The writer here may be pardoned for referring to the bucker system developed by him, which is the only battery-current system about which he has any exact knowledge. In the bucker system the generator regulation is taken care

of by a counter-electromotive force and without very much addition to the apparatus necessary for regulating the generator, a very good lamp regulator, and one almost theoretically perfect, may be added without much expense. The battery-current system of regulation, as exemplified in the bucker, employs the important principle that the varying charging current which takes place with varying speeds is a linear function of the excess-battery voltage required for charging the battery and by properly designing the apparatus a constant lamp voltage can be maintained independent of speed and lamp load, provided the battery remains within the limits of the straight-line portion of the charging curve.

Of course, it is quite possible with any type of regulator to devise some means whereby the charging process may be discontinued after the battery has become fully charged. Such devices, however, are unsatisfactory and have not to any great extent gone into general service. These devices are of necessity sensitive and complicated and their development is not likely to be prosecuted with very much vigor.

Constant-potential regulators for the generator have been and can be made. If constructed upon the voltmeter-relay principle they are, however, apt to be very unsatisfactory. The voltmeter relay is of necessity very delicate and uncertain in its action. Assuming, however, that a satisfactory and reliable voltage regulator for the generator can be obtained, it is somewhat of a question as to what voltage it should be set unless an independent lamp regulator is contemplated. If such a voltage regulator is set high enough to insure the batteries being fully charged, the voltage impressed upon the lamps will be altogether too high. A constant-potential regulator has the advantage that by its use storage batteries are pretty certain to become fully charged and never overcharged. It has the disadvantage, however, that if the batteries are in a very low or exhausted condition the generator is likely to become overloaded when it begins to charge such a set of batteries. It would seem then that the ideal generator regulator should combine the good features of the constant-current regulator and the constant-potential regulator.

It is absolutely essential that the generator voltage be equal to the battery voltage at the time the automatic switch closes, otherwise the fact that the automatic switch has closed will be too publicly advertised. It is also just as essential that the voltage of the generator shall rise high enough to force the full charging current through the storage battery with as little increase in speed above the critical speed as possible. This condition is necessary in order that the charging of the battery may begin to take place as early as possible and be continued as late as possible in order to take maximum advantage of the car's travel. The generator regulator should be so constructed that it will permit the generator to deliver its full current into the storage batteries, if no lights are turned on, at as low a speed as possible above the critical speed. To prevent overloading the generator, the regulator should be so constructed that this current will not be exceeded at any speed or on an exhausted battery or even on a dead short-circuit. As this maximum current is forced through the storage battery, its counter-electromotive force will rise and the voltage of the generator must rise also to continue to force the full maximum current through the storage battery. It is needless to state, the storage battery should be of such a size and capacity as to permit of this action. Just as soon, however, as the storage battery has become fully charged the current from the generator should begin to diminish and produce what is known as taper charge. If, however, while this process of charging is going on, lamps should be turned on, the generator should be able to furnish current immediately for these lamps so that no discharge from the battery shall be necessary, at the same time preserving the electrical conditions in the system so that no further charging of the battery shall take place if it has reached the point of being fully charged. Concisely stated, these conditions may be described as follows: A perfect generator regulator is one that tends to maintain the kilowatt output of the generator at a constant maximum without allowing either factor of the same to exceed a fixed maximum—that is to say, if a generator has a normal capacity of fifty amperes at eighty volts, which would be high enough voltage to charge thirty-two cells of battery connected in series, the regulator should permit the generator at all times to put out fifty amperes if there is anything legitimately entitled to receive this current and to limit the voltage of the generator to eighty volts. Such a regulator would, to the writer's mind, be perfect, and he is quite certain that such a regulator can be made and has been made and put into practical operation.

The means for immediately varying the strength of the current in the field of the generator may be a rheostat or a counter - electromotive force. Rheostats may be made in a variety of forms, but they should be so constructed that their steps are very fine or infinitely small, or else the passing from one step to another will be noticeable in the lamps. Rheostats for this purpose are generally constructed in one of three ways. They are either composed of definite steps or resistance brought out to contact plates or buttons over which a sliding contact passes, or they may be made of carbon disks subjected to varying pressures, or they may be made of the contacting type of which the regulator invented by S. W. Everett is a good example. A counter-electromotive force may also be employed, of which the bucker invented by the writer may be taken as a type. If any of these rheostats or counter-electromotive force devices can be controlled so as to produce the tendency toward maximum constant wattage without the factors of current and electromotive force, which make up this wattage, being allowed to exceed certain maximum values, they may be employed in the construction of an ideal regulator.

If a regulator is built along the lines and according to the requirements as set forth it will operate just as well in a one-car system as in a train-lighting system, and will, without readjustment, take care of any load within limits of capacity that is placed upon it, no matter what form that load may take. The load may be composed of the batteries and lamps on one car, or it may be composed of the batteries on one car and the lamps on a half-dozen other cars, or it may be composed of the lamps on one car and the batteries on another car, and still the regulator will, within the capacity of the generator, perform its functions in an ideal manner and the treatment that the batteries will receive will be in practical accordance with the most up-to-date ideas of storage-battery engineers. Such a regulator requires no readjustment to take care of varying schedules, changes of season or character of load.

The last problem to be considered in axle lighting is that of maintaining the lamp voltage constant. Here there is no room for any diversity of opinion. If a lamp can be found whose candlepower will not vary too widely with a range of twenty per cent variation in voltage and whose life and initial candlepower do not suffer by such variation, then the services of a lamp regulator may be consistently dispensed with. The carbon-filament lamp

certainly does not fulfill these conditions. The tungsten lamp more nearly fulfills these conditions than any other lamp that has been devised, but no one will say that a tungsten lamp or any other kind of lamp is not brighter on two-and-one-half volts per cell than it is on two volts per cell. There are some engineers in this association who may be satisfied with the approximate lamp regulation which may be afforded by throwing into circuit fixed resistances, but the writer hardly considers devices of this kind regulators. They are more of the nature of protective devices. It has been a favorite scheme with a great many designers to use the motion of the automatic switch for throwing in such resistance to protect the lamps. It has also been common practice to utilize the initial motion of the rheostat controlling the generator for the same purpose. This, however, is not regulation. It affords a measure of protection to the lamps, but it does not reduce variations in lamp voltage.

To produce or construct a theoretically perfect lamp regulator is by no means an easy task. In the first place, such an instrument must be extremely sensitive and must respond definitely to very slight changes in voltage. Variations in the neighborhood of a half a volt should cause such an instrument to respond definitely and positively. It is almost impossible to make such a device operate directly a lamp regulator whose resistance is to take care of or dissipate twenty volts and thirty or forty amperes. Consequently a lamp regulator to be sensitive and positive is generally furnished with some kind of a relay device which possesses the required sensitiveness and which in turn actuates or controls the mechanism for varying the heavy resistance in the lamp circuit proper. The actual device for taking up the drop in the lamp circuit may be either a rheostat or a counter-electromotive force or an end-cell arrangement. For obvious reasons the last is to be avoided, as the unequal charging and discharging of the various cells in the battery only add another difficulty. The steps of a lamp rheostat should be infinitely small, which practically precludes the use of a rheostat made with definite steps of resistance. The carbon disc rheostat lends itself admirably to this purpose, although it is needless to state that it is open to some objections. A counter-electromotive force may be controlled so as to produce infinitesimal variations in voltage, but here again a certain amount of complication is almost indispensable.

An ideal lamp regulator must be able to maintain constant lamp voltage, while the generator and battery voltage vary from two to two-and-one-half volts per cell, and while the lamp current varies from, say, one-half to fifty amperes. If such a lamp regulator can be devised it can be used with equal advantage in an axle system applied to a single car, or it may be used to control the lamps where the current is furnished from a head-end generator, either of the steam or the axle-driven type, or even where the storage batteries have to be charged at a terminal and the lamps used at the same time, as is often necessary when cars are cleaned at night. The lamp regulator should be carried upon the car. It must be ready at all times to reduce the line voltage to normal lamp voltage. The lamp regulator must be separate and distinct from the generator regulator and the action of one must not depend or reflect upon the action of the other. When the lamp regulator is made thus and the generator regulator as above described, a flexible, universal, interchangeable car and train-lighting system will result.

In thus attempting to outline the history of the development of the various elements comprising an axle-light system and in discussing the problems which confront the engineer and designer in meeting the requirements of such a system, the writer has endeavored to eliminate the description of specific devices either of his own or of other inventors' designs.

Fort Wayne Section, American Institute of Electrical Engineers.

The Fort Wayne Section of the American Institute of Electrical Engineers held its regular monthly meeting December 16 at the Anthony Wayne Club, Fort Wayne, Ind. The meeting was preceded by a dinner served in the club dining room, at which most of the members of the Fort Wayne Section and quite a number of visitors were present.

The regular meeting of the section was addressed by E. A. Barnes, superintendent of the Fort Wayne Electric Works, on "Choice of Power for Manufacturing Industries." The paper dealt with the kinds of power which can be used for manufacturing industries, taking up successively power purchased from central stations, power from gas-producer engines, gas engines and fuel-oil engines, and waterpower. Finally the speaker discussed the relative merits of reciprocating and turbine engines, running condensing and non-condensing, and pointed out the advantages which he claimed for non-condensing engines, asserting that the heat which can be recovered from the exhaust steam makes a saving for the factory which more than counterbalances the saving in coal consumption which can be gained by using condensing engines. Mr. Barnes presented some very interesting figures supporting his claims in this regard. The paper was followed by a lively technical discussion by many of those present who are interested in this work.

At the January meeting L. D. Nordstrum will present a paper on "Some Considerations Involved in the Design of Direct-Current Generators and Motors."

ome Handsome and Serviceable Central-Station Advertising.

The Commonwealth Edison Company, Chicago, Ill., is keeping up its reputation for fine display and attractive service in its publicity department. Among the pieces of literature which are attracting particular attention just now is a return postal-card making a Christmas suggestion of the old-fashioned kind. This postal-card bears an illustration of a beautiful Vienna portable electrolier, and the same device used as a wall lamp.

Another holiday suggestion is entitled "An Electrical Christmas." This reproduces Clement C. Moore's beautiful poem, "The Night Before Christmas," and then, in fine half-tone illustrations, shows the many novelties which might bring happiness to every member of the family in the shape of an electrically-operated utility.

The "Handbook of Central-Station Electric-Light and Power Service" delivers a series of profitable essays on "How to Obtain Electric Service," "Rates for Electricity," "Reading of Meters," "Methods of Figuring Bills," "Lamps," "Heating and Cooking Appliances," "Repair Service," and "Shops."

The beautiful souvenir of the Fisk Street power house, with a handsome cream-colored cover, illuminated with gold-leaf, is one of the most attractive pieces of literature which has been issued by anyone in a long time.

The company's publicity service is under the direction of Dana H. Howard, manager of the advertising department, who is to be congratulated upon this excellent series.

Hawaiian Electrical Notes.

The Honolulu Rapid Transit and Land Company has announced that it will shortly make a number of extensions of its service to connect with the city the various forts and military posts which are being built by the navy and war departments. Surveys have been completed for a line six miles in length to connect with the new naval station at Pearl Harbor, and a branch will also be extended eastward from the city to reach the fortifications about completed at Diamond Head. Another branch will probably be extended into the military reservation at Waikiki Beach.

The territorial superintendent of public works, Marston Campbell, will ask the next Legislature, which meets in February, for appropriations to install a 12,000-horsepower electric plant at the Nuuanu Valley Dam, now nearing completion. The new reservoir will supply water with a 900-foot head, which the superintendent plans to use entirely for power, pumping the domestic supply for the city from artesian wells. The plans also contemplate utilizing as a reservoir the concave crater of Punchbowl Hill, back of the city, which has an elevation of about 400 feet. The electric plant is also designed to light Honolulu.

The Hawaiian Telegraph and Telephone Company is the new name of the wireless-telegraph company, as authorized by the Territorial Treasurer. The company has announced, through its president, C. J. Hutchins, the acquisition of the franchise of the Standard Telephone Company, and a contract with the Automatic Electric Company, of Chicago, for the installation of a new telephone system in Honolulu. The company at the present time operates the very efficient wireless-telegraph system between the islands of the group, and the big Kahuku station, which has established successful wireless communication with the mainland. The purchase of property by the company for exchange purposes was recorded recently, and the statement is given out that an up-to-date telephone central station will be built at once. The new telephone system will be of the automatic type, and the company will install a complete underground system for its wires. The project, it is understood, has been financed through the Metropolitan Trust and Savings Bank, of Los Angeles. The company is at the present time experimenting with wireless telephony between the islands.

Notes on the Electrical Engineering Courses at the "Boston Tech."

As is well known, the Massachusetts Institute of Technology maintains strong undergraduate courses in engineering, but it is not so well known that the Institute is attended by what is probably the largest number of graduate students in any of the engineering schools in the country. There are now 215 graduate students studying at the "Tech." The degrees of these men have been conferred by colleges and engineering schools through the continent.

A notably large number of the young men studying electrical engineering at the Institute come from among these graduate students. Many of these students in the electrical-engineering course have heretofore pursued a course in arts or in general science, and are spending two or three years in completing the electrical-engineering course at the Institute. Others have graduated from other engineering schools and are spending from one to two years in study at the Institute to get its baccalaureate degree in electrical engineering; and a few of particularly high preparation are pursuing advanced study and research for the purpose of obtaining the higher degrees of master of science in electrical engineering or doctor of engineering.

It is probable that the latter students occupied in advanced study and research are enjoying the first regularly organized work in this country leading to the degree of doctor of engineering. That degree has heretofore been conferred by American engineering schools as an honorary distinction, but it has not in this country been recognized among the degrees to be secured by study and research in the schools. Brilliant work has been done by students studying for this degree in the great polytechnic schools at Berlin and Carlsruhe, Germany, and work of this nature at the Massachusetts Institute of Technology bids fair to become popular with students of the highest ability and to be influential in the development of engineering research.

The undergraduate electrical engineering course at the Institute of Technology has a senior class, which is twenty per cent larger this year than last year, and the department will soon be a candidate for larger quarters. The laboratory quarters are large and are impressive in their equipment, but even they are becoming overcrowded, and additional classrooms are much needed. The prospects of entering into larger quarters are bright with the advent of the recently-elected president, Dr. Richard C. Maclaurin.

Brooklyn Edison Section, National Electric Light Association.

The first regular meeting of the Brooklyn Edison Company Section of the National Electric Light Association was held December 14, at the Edison Club rooms, Johnston Building, Brooklyn, N. Y. G. L. Knight, chairman of the Section, presided, and 140 members attended. Although the proceedings were not completed until nearly midnight, the enthusiasm and interest were maintained throughout. After an address of congratulation and encouragement by the chairman, Secretary E. A. Bailey read letters from President W. C. L. Eglin and Assistant Secretary Harriet S. Billings, of the National association, both of whom referred to the first number of the bulletin of the Brooklyn company's Section in terms of praise, President Eglin declaring that this publication set a standard and a pace that it would be difficult for other company sections to excel.

The bulletin, which was distributed to those present, contained, in addition to editorial and news matter of general interest to the members of the Section, the complete text and illustrations of all the papers presented on the occasion.

The first paper of the evening was on "Modern Power Plant Design," by F. W. Harrison and M. J. Shugrue. The paper was illustrated by lantern slides, and the subject was treated under the following headings: The building, coal, steam, electrical energy, switch-house, control board, switches, exciters and connections.

The next paper, entitled "Developments in Incandescent Lamps," was also written and delivered in two sections; the first section, viewing the subject from a manufacturing standpoint, by E. B. Rannells, and the second, on the reasons for higher efficiency, and the commercial bearing of the new developments, by M. S. Seelman, Jr.

The last paper of the evening, entitled "Some Notes on the Friction of Shafting," was written by C. A. Graves, and was a practical discussion embodying some interesting and useful data.

After the reading of the papers was completed, the members took up their discussion in a very spirited and general manner.

The next session will be held in February.

Electric Driving of a German Portland Cement Mill.

BY DR. ALFRED GRADENWITZ.

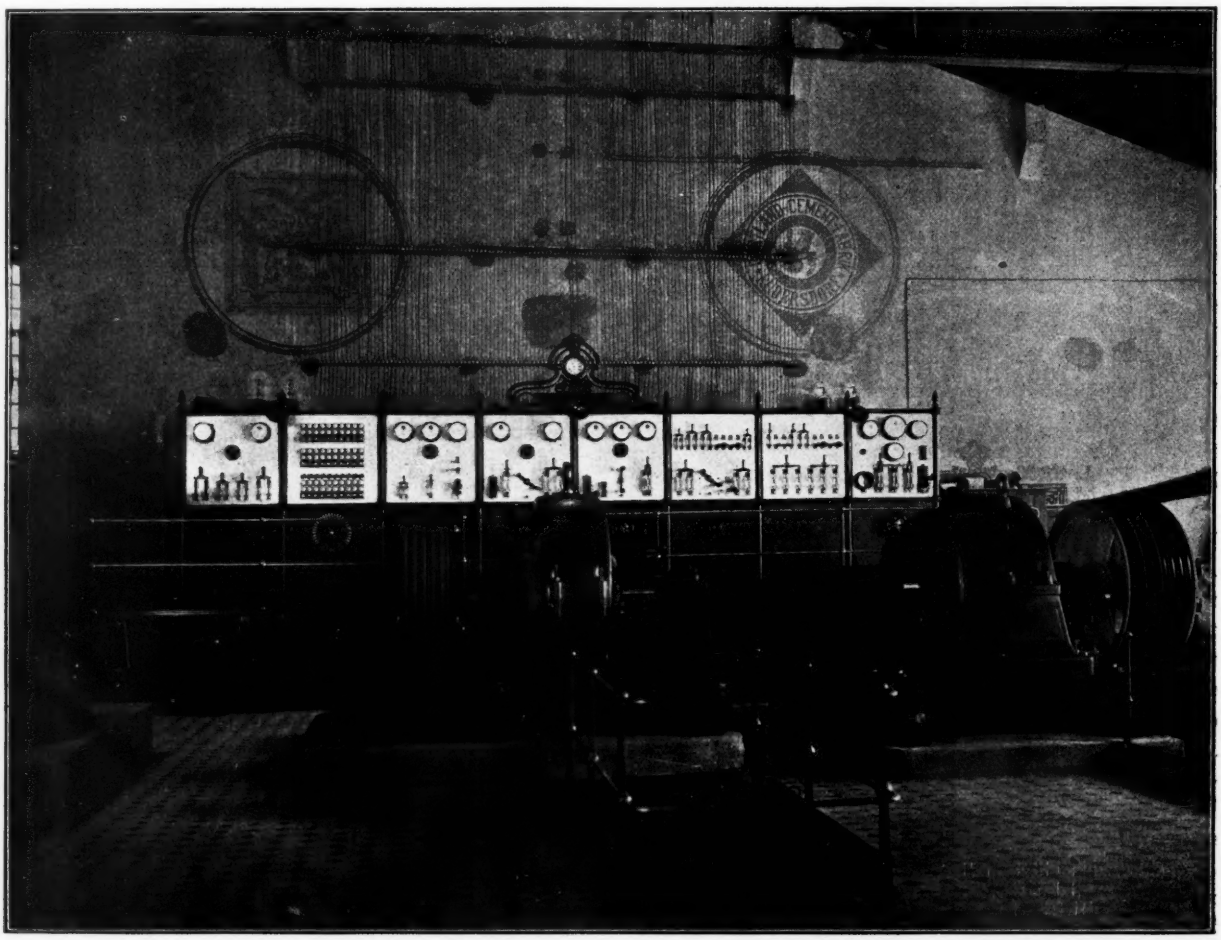
Portland cement, a combination of lime and slate-holding materials, when stirred with water is known to harden after a given time without any deformation, and is a most valuable material both for the making of mortar and the construction of foundations, etc. The methods of manufacturing Portland cement have been thoroughly modified since the introduction of mechanical operation. Whereas the raw materials formerly were crushed and mixed in stirring tanks in order then to shape the mud into bricks, which after drying were burned in the furnace into clinkers, mechanical operation has now been substituted for hand labor, not only in driving the crushers, crushing rolls, drying drums and grinding mills, but for all the transporting devices used in connection with cement manufacture. The number of hands required is thus reduced considerably and the troublesome production of dust is kept within very low limits by the installation of ventilating fans.

FIFTY-HORSEPOWER MOTOR, DRIVING CRUSHERS AND ELEVATORS.

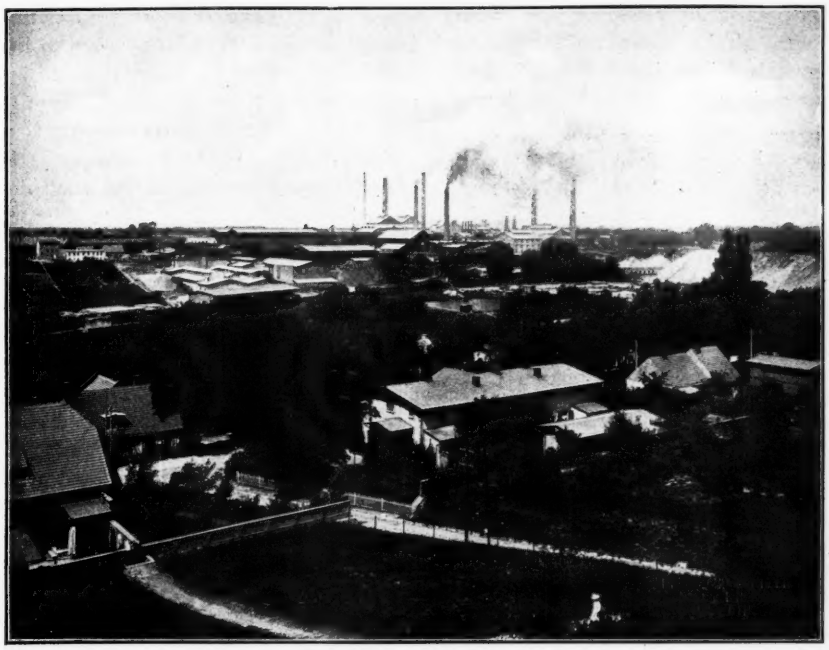
The most interesting point of mechanical operation, however, is the use of rotary kilns in the place of the pit or ring furnaces formerly used, which dispenses with any shaping and transporting work, thus reducing considerably the number of workmen. In fact, the material throughout the regular course of operations never once comes into contact with the shovel of a workman. After being raised to the higher stories by means of elevators, the raw materials (as well as the clinkers) are transported in vibrating chutes in a horizontal direction, whereas the finely ground substances are moved on by worm conveyors.

It will be readily understood that electric motors are specially adapted for the operation of the various kinds of machinery used in connection with this extensive process as well as of the conveyors and ventilating fans, though on account of the low speeds of these machines there is no possibility of using a direct coupling between the machines and motors.

One of the largest and most interesting German cement works in which electric drive has been recently adopted is the Rüdersdorf Portland Cement Fabrik



DIRECT-CURRENT MACHINES AND SWITCHBOARD, RÜDERSDORF PORTLAND CEMENT WORKS.



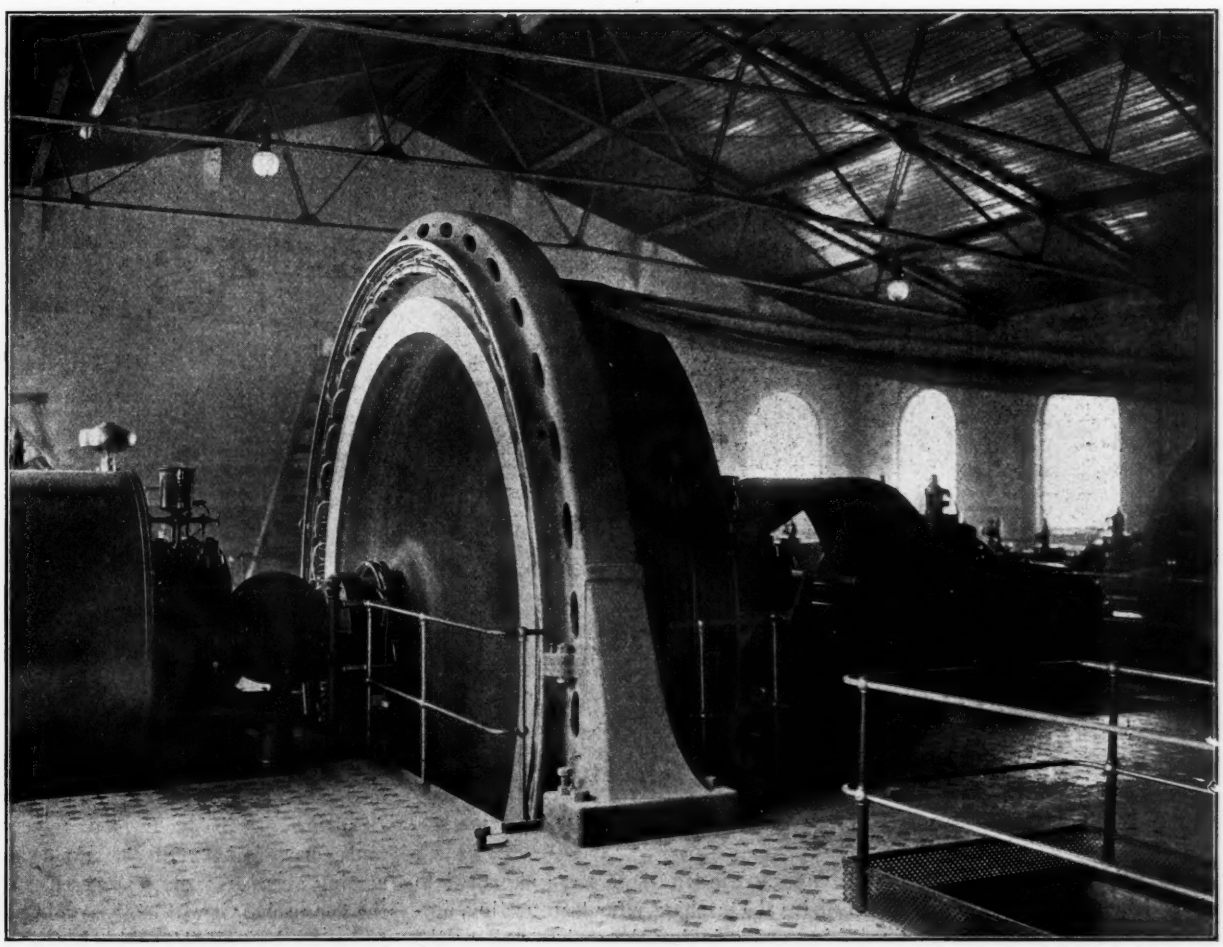
THE RUDERSDORF PORTLAND CEMENT WORKS.

(near Berlin), which has been recently electrified by the Siemens-Schuckert Works.

The equipment comprises a 500-volt polyphase generator of 700-kilovolt-ampere rating coupled to a steam engine, and two direct-current machines of 220 volts and 970 and 610 amperes, respectively. In addition to the supply of power to the factory these generators serve for lighting the works as well as supplying light and power to the neighboring community of Tasdorf. A storage battery is connected in parallel to the direct-current machines. No appreciable influence is exerted on the luminous intensity of the lamps actually in circuit by inserting the motors. The following short description of the manufacturing process will fitly illustrate the various uses of electricity made in this cement plant.

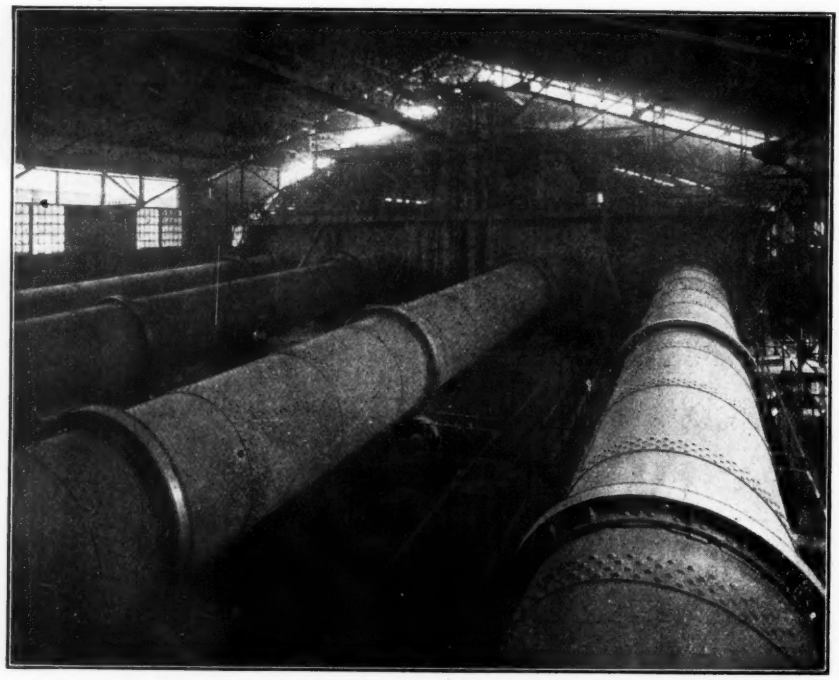
The first part of the operation consists of crushing the limestone in crushers and the slate in crushing rolls. After having been dried in drums the crushed raw material is mixed in predetermined ratios and ground in tube mills driven by two electric motors of 200 horsepower each. From the mills the powdered cement mixture is taken by electrically operated worm conveyors and elevators to the bins and bunkers on top of the four rotary kilns.

These kilns, constructed by the machine



POLYPHASE ALTERNATING-CURRENT GENERATOR, 700 KILOVOLT-AMPERES, 500 VOLTS, : RUDERSDORF PORTLAND CEMENT WORKS.

works of Polysius, Dessau, are practically horizontal tubes twenty-six metres in length and 2.1 metres in diameter, rotating slowly about their axes. A steady supply of the powdered mixture is introduced at the higher end, while the fuel (in the shape of coal dust) is blown in by an air blast at the lower end. The mass is slowly heated to sintering, and during the rotation of the kiln, owing to the inclined position of the tube, moves toward the fire end, situated at a lower level, where the burnt clinkers of nut size leave the drum, to be taken directly to the inclined rotary cooling drums which are situated parallel to the rotary kilns on a lower floor. Each of the four kilns and coolers is operated by a thirty-horsepower electric motor. Electric motors are also used to drive the machinery for transporting, drying and grinding the coal as well as the blowing in of air and coal.



ELECTRICALLY DRIVEN ROTARY :KILNS, RUDERSDORF PORTLAND CEMENT WORKS.

MOTOR DRIVING CEMENT-GRINDING PLANT, :RUDERSDORF PORTLAND CEMENT WORKS.

The finished clinker is taken by vibrating chutes from the rotary coolers to the ball-tube mills to be ground to a fine powder by steel balls. These mills require two motors of 200 horsepower each.

An aggregate of 1,400 horsepower is used for power purposes in the plant described.

Third Avenue (New York) Receivership.

Frederick W. Whitridge, Federal receiver of the Third Avenue Railroad Company, in New York city, in an order signed by Judge Lacombe, is directed to pay William L. Ladd, state receiver of the New York City Railway Company, $42,772, with interest from May 1 last, at the rate of six per cent, the value of coal and other supplies rendered to Whitridge by Adrian H. Joline and Douglas Robinson, former receivers of the Third Avenue Railroad.

Receiver Ladd, in the petition which he presented to the court, valued the property at $51,000. Judge Lacombe, however, on the question of other property involved in the receivership controversy, appointed William L. Turner special master to take testimony and to decide as to its ownership.

New York State Public Service Commission.

The transportation companies reporting to the Public Service Commission for the First District gives the following list of accidents in November, with comparisons:

	Nov., '08	Nov., '07
Total accidents	3,992	4,037
Killed	36	45
Seriously injured	169	198

The total for November is 676 less than for the previous month, and the number of persons injured in getting on and off cars approximates one-half the figures for June and July.

Hell Gate to Be Bridged.

After the Pennsylvania Railroad has advanced farther with its terminal station and other improvements in and about New York city, work will be started on a bridge from Port Morris, a suburb of New York, to Queens County, Long Island. It will be used by the New York Connecting Railroad, a branch of the Pennsylvania system. As planned, the bridge in many respects is to be one of the most remarkable engineering structures ever proposed. With the approaches, it will be three miles long and span the Hell Gate ship channel with an enormous arch 1,000 feet in the clear.

FUEL ECONOMY TESTS AT A LARGE OIL-BURNING ELECTRIC POWER PLANT.

BY C. R. WEYMOUTH.

The writer desires to present the results of various fuel-economy tests at the Redondo plant of the Pacific Light and Power Company, near Los Angeles, Cal., which are of interest, both by reason of steam engines having been used as prime movers and because of the notable economy attained. Owing to the rigorous demands on commercially-operating power stations, an opportunity is seldom afforded to conduct uniform-load tests on a complete plant unit.

The station consists of three main units of 5,000 kilowatts each, the layout being in general on the panel system. For each plant unit there is one McIntosh and Seymour double horizontal and vertical, compound, condensing, automatic engine, size thirty-four and seventy by fifty-six inches, directly connected to an alternator. The rated speed is 100 revolutions per minute. Each engine has two horizontal high-pressure steam cylinders, and two vertical low-pressure cylinders, and is designed to operate at 175 pounds maintained throttle pressure, with 100 degrees F. superheat at the throttle. All steam cut-off valves are under control of the one shaft governor. This engine governor is subject to variation in speed, under the control of a McIntosh and Seymour electrically operated, speed-changing mechanism, situated within the governor and operated from the switchboard gallery.

Directly connected to each engine there is an ATB-sixty-pole, 5,000-kilowatt, 100-revolutions per minute, 18,000-volt, fifty-cycle, three-phase General Electric generator of the fly-wheel type. The revolving field is provided with squirrel-cage winding to prevent hunting. The generator field rheostats are motor-operated, with remote control from the switchboard.

In each plant unit are six Babcock and Wilcox boilers of forged-steel construction, arranged in three batteries of two each. Five boilers are intended for the nominal capacity of the unit, the sixth boiler for reserve. The boilers are twenty-one sections wide, fourteen tubes high, eighteen feet long, with three forty-two-inch drums, each containing a total effective water-heating surface of 6,042 square feet and designed for 200 pounds working steam pressure. Each boiler is equipped with one Babcock and Wilcox forged-steel double-loop superheater.

The boilers are provided with Peabody patent fuel-oil-burning furnaces, having a furnace depth of ten feet from boiler front to face of bridge wall. The burner head is placed at the bridge wall, the flame shooting toward the boiler front. The furnace diverges in the direction of the flame, corresponding to the angle of inclination of boiler tubes. Three burners are used per boiler, and are controlled from the boiler front.

Corresponding to each main generator, there is one seventy-five-kilowatt General Electric exciter, driven by means of a nine and seventeen by twelve-inch Harrisburg tandem compound, non-condensing, piston valve, automatic engine.

There are two Wheeler condensers for each main engine, located in the basement below the operating floor, one condenser being used for each low-pressure cylinder. The exhaust steam is led directly from the low-pressure cylinder into a thirty-inch exhaust main, and after passing through a ninety-degree sweep, drops directly into the condenser. The two condensers on each engine are cross-connected, so that both engines can exhaust into either condenser when the other is undergoing cleaning or repairs. Each condenser contains 5,002 square feet of cooling surface, consisting of three-fourths-inch brass tubes. In addition to the regular cooling surface of each condenser, there is provided in the upper compartment a series of tubes, comprising a Volz heater, through which the condensed water is pumped by the air pump at atmospheric pressure. The feed water is thus heated to within a few degrees of the temperature of the exhaust steam surrounding the upper tubes, thus compensating for the cooling action due to the lower condenser tubes.

Circulating water is supplied by three large engine-driven centrifugal pumps, connected to a common pump-discharge main. Branches from this main supply cooling water to all condensers. The outlets from all condensers connect to a common condenser-discharge main. Each condenser has one Edwards triplex, motor-driven air pump, size sixteen by ten inches.

After passing through the Volz heaters the condensed water is passed through suitably constructed filters for the elimination of the greater part of the entrained cylinder oil. The outlet of the filters is connected to the feed-pump suction main, the supply of water being maintained by an open equalizing hot well, which is also connected to the suction main.

Each unit has one Snow duplex, horizontal, boiler-feed pump, having a compound, non-condensing steam end and an outside center-packed water end. Each unit also contains one auxiliary, Goubert vertical, closed, feed-water heater, of the multiple-flow type, having 1,000 square feet of effective tube-heating surface.

The condensation in the main-engine superheating receiver coils is led to a simple duplex receiver pump. The hot water, at a temperature of about 360 degrees, is returned under boiler pressure to one or more of the boilers in the corresponding unit. The oily drips from receiver bodies are trapped to waste. From the auxiliary measuring tanks, the fuel oil is first pumped through a Goubert closed, multi-flow oil heater, in which the oil is heated to a temperature of approximately 150 degrees F., utilizing the exhaust steam from the oil-feed pump. From the oil heater the oil is led to an oil-pressure main and thence to the oil burners through a suitable system of piping.

An automatic system of regulation was employed for the firing of all boilers in the unit tested, hand firing being used on the remainder of the plant. The automatic system controls the supply of oil to the burners, the supply of steam for atomizing purposes, and the supply of air for combustion. This control is obtained through a steam-pressure regulator which operates a relief valve in the oil-pump discharge line, and is actuated by the variations in steam pressure in the boiler. This means of control causes a variation in the rate of burning oil comparable with the momentary load. With this system, all burner valves may be left wide open, or nearly so, and it follows that the intensity of firing increases or decreases simultaneously in all the boilers.

The supply of steam to burners for atomizing purposes is from a low-pressure steam main, the controlling valves at each of the burners being left wide open or nearly so. The variations in pressure in this main are governed automatically by variations of the oil pressure in the oil main. The regulator used throttles the supply of live steam to the low-pressure main, to produce the desired relationship of oil pressure and steam pressure on the respective burner heads. The supply of air for combustion is automatically regulated by a damper controller, operating a common rock shaft, connected to all

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boiler-outlet dampers. This regulator opens and closes all boiler dampers synchronously with an increase or decrease of oil pressure in the oil main.

This system is capable of such operation as to control all of its functions completely and automatically. In actual practice, however, it has been found desirable to watch closely the firing of boilers, to make certain that no external conditions, such as clogging of burners, distortion of flames by burners, variation in temperature of fuel oil, as fired, etc., are present to prevent the attainment of the highest possible efficiency. To minimize heat losses due to radiation, all live steam heat-radiating surfaces are covered with non-conducting covering three inches in thickness, and other surfaces are covered in accordance with the dictates of good practice.

OUTLINE OF TESTS.

The data and results given herein are based on the following tests:

a. Official fifteen-day variable-load test on No. 2 plant unit.

b. Uniform-load test at approximately 2,000 kilowatts output No. 2 plant unit.

c. Uniform-load test at approximately 3,000 kilowatts on No. 2 unit.

d. Uniform-load test at approximately 4,000 kilowatts output No. 2 unit.

e. Uniform-load test at approximately 5,000 kilowatts output No. 2 unit.

f. Test complete plant at variable load similar to the official test.

These tests are more fully described under their respective headings.

OFFICIAL FIFTEEN-DAY TEST.

The official test of this station was on No. 2 plant unit, and was made to determine the economy of the plant under contract conditions, as a basis for computing the bonus earned by the contractor, or the penalty due the owner. The result of this official test is now common knowledge, but not all the conditions surrounding the test have been heretofore published; and as the result of the official test on variable load is of interest for comparison with the results of the uniform-load test, herein presented, the writer desires to review the more important conditions attending the official trial. The contract placed the official test under control of a testing committee. The contractor's commercial-load economy guarantee was as follows:

> The company guarantees * * * that the "first unit" * * * when operating on commercial-railway load, under ninety days' test, conforming to the conditions herein specified, will develop an average economy of 170 kilowatt-hours per barrel of oil.

The total net output of unit under test for each day will not be less than 60,000 and not more than 78,000 kilowatt-hours.

The main unit under test will be in operation during nineteen-and-one-half consecutive hours per day, and will be shut down four-and-one-half hours per day. The temperature of circulating water entering the condensers will never exceed seventy degrees Fahrenheit.

The power-factor of the electric load will be at all times between eighty and 100 per cent. Total load on 5,000-kilowatt alternator will never exceed 6,000 kilowatts. The load on 5,000-kilowatt generator greater than 5,000 kilowatts will last for an interval not greater than one-half minute duration; and there will be not to exceed ten such intervals during any hour that the plant is under test.

The load on the unit under test will be such as would be produced by the regular and normal working of the railway system to which the power is furnished by the purchaser, and varying within the limits herein described.

The load will not be manipulated so as to be either favorable or unfavorable to the showing of unit under test, within the limits herein specified.

It was optional with the contractor to insist on the operation of the test unit on a separate transmission line. This would have inconvenienced the purchaser, and for operating reasons a compromise was effected, it being agreed to operate the test unit during the official test in accordance with an agreed load curve, subject to certain upper and lower limits.

The control of the load during test was thus left entirely to the purchaser's station operator within the specified limits and subject to such momentary variations as would be imposed on the test unit by the fluctuation in load on purchaser's system. It was thus attempted to generate a total of 72,280 kilowatt-hours per day, with the understanding that should the total kilowatt-hour output up to any hour exceed that shown by the load curve, then, during the remainder of the test period, the load was to be modified to correct for any variation in the total output, so as to maintain the total daily output of the unit uniform and as agreed.

Endurance features having been established, by reason of the long period of operation previous to the test, the period of test was subsequently reduced from ninety to fifteen days. And, owing to certain advantages that might accrue to the contractor, such as superior economy due to shortening of test, the contractor agreed to deduct from the bonus otherwise due the sum of $50,000 in consideration of this reduction of test period.

The economy guaranteed initially included the provision for lighting the unit under test from energy generated by the test unit. Correction for lighting was made by deducting from the total net output of the unit under test an amount of power equivalent to 125 kilowatt-hours per day, and the reported economy is based on the net figure after making this deduction.

During the test the power for operating the air-pump motors, for operating motors connected to circulating pumps used for passing cooling water through engine bearings and guides, for operating electric motor in main engine speed-changing device, and for operating electric motor for controlling switches, was taken from the leads of the main generator in such a way as to compel the wattmeters to indicate only the net useful output of the unit.

It is only fair to state that, owing to the layout of the plant, certain auxiliary apparatus in connection with the plant was installed by the purchaser, power for which was not taken from the unit under test. These auxiliaries, with the exception of the circulating pumps, are not necessarily essential in the guarantee of power; that is, they may or may not be required in a power plant, depending upon local conditions, etc.

During the tests special weighing and receiving tanks were provided for the measurement of the fuel oil required by the unit under test. After weighing, the oil was emptied into a receiving and heating tank, the heating being done by steam from the unit under test, and from there conveyed by gravity to the oil-feed pump used for feeding oil to the burners.

All instruments were accurately calibrated and standardized. For purposes of the tests a total of twelve integrating wattmeters were purchased, and, after calibration in place under conditions of operation, it was finally decided to determine the power output by using one wattmeter in each phase of the generator, there being three reserve wattmeters. Meters were connected in the main winding of the generator between the grounded center of the winding and the winding itself.

A large corps of assistants and observers was employed during the tests. At one time a total of eighty persons was directly involved. The neutral observers, including the members of the graduating classes in electrical and mechanical engineering of the University of California, were under the direction of the chairman of the testing committee. In all details

of the test care and accuracy, in keeping with the importance of the desired results and the amount of bonus money involved, were observed.

UNIFORM LOAD TESTS.

During the uniform-load tests the same general conditions prevailed as during the official trial, except as herein indicated. Though unofficial, the determination of fuel burned and power output during the uniform-load tests was still under control of the testing committee and the same corps of observers, although the wattmeter readings were taken less frequently, as a result of experience during the official trial. The calculated economies given are obtained from the readings made by the neutral observers. It should be stated, however, that the testing committee never completed any official report for these uniform-load tests, as the results of the uniform-load tests were of no consideration in determining the amount of bonus to be paid the contractor.

VARIABLE-LOAD TEST OF THE COMPLETE PLANT.

During this test the entire plant was operated under commercial conditions of load, except that an attempt was made to follow on all three units the load curve used during the official test. The circulating pumps were supplied with steam from the various boilers, and all plant auxiliaries, including those omitted from official test, were included in the complete plant test. All these last-named auxiliaries were not in use at all times, however. The output of all units was determined by means of station wattmeters which have since been carefully calibrated by the purchaser, and the correction factors as found applied to the observed readings.

This test did not in any sense do justice to the plant, owing to operating conditions, as explained below, and for this reason the test was protested by the writer and at the time was discarded by the testing committee. The writer has since felt, however, that the result is of interest, and offers it with this explanation.

OPERATING CONDITIONS DURING TESTS.

During all the tests the plant was handled by the regular station operators under the control of the contractor's superintendent of construction.

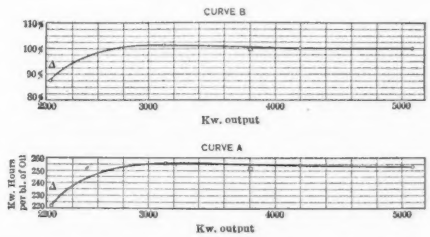
The load was quite variable, necessitating constant adjustment of auxiliaries, oil burners, dampers, etc. On boilers of No. 2 unit, the automatic system of firing was used during the official test and during uniform-load tests. Control of oil burners and dampers on No. 1 and No. 3 units during the complete-plant test was by hand.

The contractor's experts were present during all tests, and cautioned the operators when necessary. Much credit is due them for the exceptional performance of representative apparatus.

During the official fifteen-day test certain unfavorable conditions predominated, for which no correction has been made in the stated economy. Owing to the accumulation of seaweed in the circulating-water pipe line, and the interruption of flow of circulating water through the condensers, there were intervals when either one or both condensers of the test unit operated at a reduced vacuum, and at other times it was necessary to run the engine non-condensing. Frequent shorts

TABLE SHOWING RESULTS OF VARIABLE AND UNIFORM LOAD TESTS ON ONE 5,000-KILOWATT UNIT, ALSO VARIABLE LOAD TEST ON COMPLETE PLANT, AT REDONDO, CAL.

Designation of Test	Unit	Variable Load Average of 15-Day Tests	2,000-Kw. Load Test (Approximate)	3,000-Kw. Load Test (Approximate)	4,000-Kw. Load Test (Approximate)	5,000-Kw. Load Test (Approximate)	Variable Load Complete Plant Test
Date of starting test	1908	April 18	May 14, 10:30	May 19, 8 a. m.	May 18, 10 a. m.	May 5, 12 noon	May 21, 11 a. m.
Date of stopping test		May 4	May 14, 3:30	May 19, 11 p. m.	May 18, 12 m. n.	May 5, 11 a. m.	May 22, 11 a. m.
Duration of test	Hours	24	5	13	14	23	24
Time of starting fires			5:10 a. m.	3:00 a. m.	5:10 a. m.	4:35 a. m.	5:05 a. m.
Period of warming boilers	Hours		5:20	5:00	4:50	7:25	5:55
Average steam pressure at engine throttles	Lb. per sq. in.	180.03	183.	181.74	180.9	189.3	173.76
Average superheat at engine throttles	Deg. F.	82.46	87.99	92.	96.05	92.78	95.15
Average temperature circulating water inlet	Deg. F.	63.03	61.64	61.41	61.34	62.4	59.33
Average temperature circulating water outlet	Deg. F.	79.15	78.09	79.37	79.02	81.09	82.12
Average vacuum in condenser (Corresponding 30 in. Bar.)	In. Hg.	28.334	28.426	28.343	28.214	27.976	27.784
Average temperature of feed water leaving heater	Deg. F.	146.9	184.3	167.8	155.9	150.7	177.22
Kilowatt output (including lights)	Kw.-hr.	71,615.24	11,225.577	47,126.457	58,745.125	116,899.748	215,262.438
Net kilowatt output, deducting lights	Kw.-hr.	71,490.24	11,199.535	47,048.332	58,665.208	116,781.956	
Fuel oil as fired (334 lb. to bbl)	Bbl.	303.387	50.01	195.458	244.783	496.910	957.566
Heat units per pound oil as fired	B. t. u.	17,840.	17,938.8	17,920.8	17,965.8	17,838.	17,717.
Sulphur in oil (by weight)	Per cent	2.34	2.17	2.43	2.39	2.49	2.60
Moisture in oil (by weight)	Per cent	2.38	1.82	2.08	1.895	2.70	2.59
Silt in oil (by weight)	Per cent	.14	.138	.14	.113	10	
Fuel oil corrected as per contract	Bbl.	282.746	47.219	183.307	230.764	460.884	883.115
Economy (oil corrected as per contract)	Kw.-hr. / Bbl.	252.842	237.298	256.664	254.252	253.382	243.758
Economy (oil corrected as per contract)	B. t. u. / Kw.-hr.	24,438.	26,039.	24,074.	24,302.	24,386.	25,349.
Economy corrected only for heat units, in oil	B. t. u. / Kw.-hr.	25,288.	26,742.	24,857.	25,027.	25,347.	26,320.
Number of boilers in service	No.	5	3	5	5	6	15
Combined efficiency of engine and generator based on separate exciter	Per cent		90.2	92.5	94.1	94.75	



CURVES SHOWING ACTUAL AND RELATIVE FUEL ECONOMY AT FRACTIONAL LOADS, 5000-KW. UNIT.

Curve A Shows Fuel Economy at Various Fractional Loads in Kilowatt Hours per Barrel of Oil. Curve B Shows Relative Fuel Economy at Fractional Loads as Compared with Economy at Rated Load of 5000-kw.

occurred on the lines, and again periods of excessive overload. During the official test, instead of following the comparatively smooth load curve agreed, momentary changes in load were of considerable magnitude. The actual load curves show a marked saw-tooth effect, momentary changes being so violent as to cause unfavorable economy, these variations in load not only affecting the economy of the prime mover, but also the performance of boilers, the continual change in rate of oil firing, air supply, steam supply to burners, etc., making it impossible to secure the best results, although the automatic-firing system employed on No. 2 unit no doubt greatly reduced such losses.

Certain of the uniform-load tests were of comparatively short duration. The results of such tests are therefore subject to slight error. The initial period of starting the uniform-load tests was determined by the testing committee, and while the writer has reluctantly assented to certain of these intervals, it will be self-evident that for certain of these tests the period allowed for warming up boilers before starting of test was not sufficient to eliminate all of the heat storage effect, and is not fully in accordance with the society's rules for conducting such trials. Previous to certain tests the boilers had been down for such lengths of time as to be practically cold. In other cases the boilers had been at stand-by for four or more hours previous to starting fires, except during the 3,000-kilowatt test where the boilers after previous day's run were kept up to steam pressure by intermittent firing. The results, therefore, from this standpoint are slightly unfavorable, the fuel consumption stated involving to some extent the fuel loss due to warming up the boilers.

The test for the 2,000-kilowatt load was made with three instead of five boilers in operation, as is the regular practice at this plant during any prolonged running at such loads. Owing to the short period of the test, it would have been impossible to keep the two idle boilers on the line and fire at intervals during the test in such a manner as to guarantee the same amount of heat storage in the idle boilers at both commencement and end of the test period. The amount of such loss due to stand-by of the idle boilers was therefore determined separately by actual measurement, and the resulting fuel loss is given in the accompanying table, corresponding to which due correction in economy has also been figured. The amount of this correction corresponds to the heat necessary to keep the two idle boilers continuously up to full boiler pressure. It is a fact, however, that the actual stand-by loss was less than this amount, owing to the reduction in the rate of heat radiation which takes place after the boiler has appreciably cooled.

During the uniform load tests it was necessary, owing to peculiar conditions of operation, to lower materially the power-factor of the unit under test in order to control the load on same more readily. Owing to this lowering of the power-factor below the range for which the watt-meters were carefully calibrated, an error was introduced in the readings, manifesting itself in a tendency of the meters to run too slow, thus indicating an output less than actual. Further, owing to the lower power-factor imposed on the main generator, the C^2R and other losses were greater than normal (80 to 100 per cent), causing a falling off in generator efficiency and consequent reduction of fuel economy.

During the complete plant test the head on the circulating pumps was measured and averaged in the neighborhood of thirty-five feet. This excess head is due to the fact that the purchaser met with certain reverses in the installation of the circulating water pipe line, making it necessary to install internal angle iron strengthening ribs. The suction and discharge piping is also subject to certain air leakage and to a considerable accumulation of seaweed both in the main suction line and in the suction line strainers. As a result of this condition, not only were the total head and duty imposed on the circulating pumps during the complete plant test exorbitant, but the quantity of circulating water handled was not quite sufficient for the most economical vacuum requirements when all three units were in operation. During all these tests certain unfavorable conditions existed as to the character of oil burned and the treatment of same preparatory to burning.

OBSERVED DATA.

In the accompanying table is given a summary of the observed data and the calculated results for the various tests, including averages of steam pressure at engine throttles, superheat at engine throttles, condenser vacuums, circulating water temperatures, etc.

FUEL OIL SPECIFICATIONS AND CORRECTIONS.

Certain arbitrary corrections were agreed on in formulating the guarantee of this plant, and the nature of such corrections should be well understood in order to gauge the value of the results herein given and the possible error that may have been introduced by reason of such corrections.

It is well known that with the poorer grades of coal, having excessive quantities of ash, sulphur, moisture and other volatile matter, there is a falling off in the furnace efficiency as compared with the combustion of the better grades of coal; so with crude oil having excessive quantities of moisture, sulphur and silt, or of low specific gravity, there is an appreciable falling off in the furnace efficiency as compared with a grade of crude oil of average quality. It is certain, however, that most of the losses due to foreign matter are less with oil fuel than with coal, but the exact extent of these losses is so far unknown.

During the preliminary negotiations for the Redondo plant the contractor's guarantee of 170 kilowatt-hours per barrel of oil was based on an average quality of Bakersfield crude oil, of known furnace performance, having the following specifications:

Specific gravity, sixteen degrees Baume.
Corresponding weight per barrel, 336 pounds.
Heat units per pound of oil calorimeter test, 18,500.
Moisture limit, one per cent.
Sulphur limit, one-half per cent.

On the day of closing the contract the purchaser insisted on testing the plant with oil secured from the purchaser's near-by wells; and while this oil never had been used during any authentic boiler trials, yet it was known to be of low gravity and low in heat units, to have considerable quantities of both moisture and sulphur, and in general to be a decidedly inferior grade of oil.

After some discussion a compromise was effected whereby the economy guarantee was allowed to remain as stated, the oil specifications being changed to the following:

Minimum specific gravity of oil fourteen degrees Baume.
Maximum specific gravity of oil, eighteen degrees Baume.
Agreed weight per barrel, 334 pounds.
Minimum heat units per pound of oil, 17,000.
Moisture limit, five per cent.
Sulphur limit, two-and-one-half per cent.
Silt, etc., limit, one-half per cent.

It was finally agreed that in addition to correcting on the heat-unit basis a further correction should be made for the

presence of sulphur exceeding the limit of one per cent or moisture exceeding one-half per cent, and the purchaser should be penalized by deducting as oil from the weight of oil fired the weight of all moisture in excess of one-half per cent, all sulphur in excess of one per cent and all silt and other foreign matter.

It is a well known fact that oil, low in gravity, requires an excess of steam for preheating in the auxiliary suction tanks, both for the preliminary treatment of the oil in an attempt to remove the excess of moisture and silt by warming and also to enable the oil pressure pumps to lift this oil, under suction without danger of interruption in the pumping of oil to the burners. It is also well known that all crude oils are complex mixtures of various hydrocarbons, that distillation takes place to varying extents at all temperatures, and that the higher the temperature to which the oil is heated in an open tank the greater the loss due to such distillation.

It is further well known that the heavier the oil the greater the amount of heating necessary in the pressure heaters between pumps and burners, where heat is added to facilitate atomization of the oil and to economize in the amount of steam necessary for such atomization. In addition to the general falling off in furnace efficiency, due to the poorer grade of crude oil, there was a further and rather indeterminate loss due to the effect of sulphur and silt, which caused a slight clogging and corrosion of the burners and at times a distortion of the flames. The sulphur fumes from the products of combustion also escaped from the boiler setting, causing a serious annoyance to the firemen and necessitating an excess of air supply to overcome the trouble.

With our present knowledge of the combustion of oil fuel it is impossible to rationalize the results of the Redondo tests so as to determine exactly the true thermal efficiency that would have been attained had an average grade of crude oil been used. During the tests, as will be noted from the values given in the table, the grade of oil used was of very low specific gravity and contained excessive quantities of moisture, sulphur and silt. It is indisputable that an appreciable loss in efficiency resulted from the presence of these foreign substances, but owing to the arbitrary nature of the corrections made the plant economies herein stated may be in error by small percentages, the amount of which must remain indeterminate. This criticism will likewise apply to all similar tests which are not made with a grade of fuel recognized as standard.

As a matter of interest there are included in the table figures showing the plant efficiency, omitting the contract corrections; it must be borne in mind, however, as above stated, that these figures evidently represent a lower economy than would have been obtained with the standard grade of oil specified.

Considerably better economy would be expected in the uniform load tests than was secured in the official test, namely, 252.842 kilowatt-hours per barrel of oil. The actual results were not very much higher, however, for as already explained the period allowed for warming up the boilers before starting certain of the uniform load tests was not sufficient to overcome the loss due to radiation during the lay-over period, and the results were lower than they should be on this account. It should also be borne in mind that in the so-called uniform load tests the actual load varied from time to time, requiring a constant adjustment of oil burners, dampers and auxiliary apparatus, and while the magnitude of these variations was small, yet the variation in load was such as to cause a loss in economy as compared with an absolutely uniform load. The economy obtained at the various uniform loads is plotted in the curve shown. The economy at various fractional loads as compared with the economy at the rated load is also shown in the same diagram.

Inasmuch as the absolute economy at the various uniform loads is probably greater than reported, for reasons pointed out above, and as the correct economy at the uniform load tests would probably be a small but uniform percentage greater throughout all of such tests, it is fair to assume that the relative economies as shown are reasonably accurate, and for this reason the writer considers the curve showing the relationship of economies at various loads to be of greater value than the results of individual tests. There have also been plotted the points corresponding to three in lieu of five boilers, for 2,000-kilowatt load, for both of the above curves, as well as the economy obtained for the official test for the equivalent average load.

In studying these curves it should be borne in mind that the results given indicate the entire falling off in fractional load efficiency for the complete plant, being the multiplied effect due to various losses, such as electrical efficiency of generator, mechanical efficiency of engine, indicated economy of engine, auxiliary performance, and the greater effect at light load of dead load losses, such as heat radiation from exposed piping and other radiating surfaces, and the loss in efficiency of boilers owing to operation at fractional loads. As the total effect of all these losses is relatively small, it is in itself evidence of the high maintained steam economy of the prime mover at very light loads. The combined efficiencies of engine and generator are shown in the table, and as this falling off in efficiency at light loads is quite apparent it offers additional evidence as to the maintained indicated economy of engine at fractional loads.

A falling off in economy would be expected for the complete plant test of all three units as compared with the official test of No. 2 unit for many reasons; among these are the excess of head imposed on circulating pump, the deficiency in quantity of circulating water causing a severe loss of vacuum at intervals, and at the completion of test the operation of the plant non-condensing; the use of energy from the plant to operate a fifty-horsepower motor driving a duplex vacuum pump, necessary to remove air leakage in suction line; the use of energy in pumping water from the plant for operating motor-driven oil pumps in pumping oil from main oil tanks to auxiliary oil tanks; the use of energy from plant in pumping well water from the purchaser's wells to the plant; the energy used for pumping out sumps; the energy used for lighting various surrounding buildings and wharf; the necessity for hand control of firing the boilers of No. 1 and No. 3 units, the automatic system being in use on No. 2 unit only. Considering all of these conditions, the economy for the complete plant is very favorable indeed.

As having a bearing on the economy of the plant, the writer would explain that to conform to the contract load requirements during test, which are designated as the maximum requirements of the plant during commercial operation, and further to economize in the first cost of plant, the main engines were initially selected to have a normal rated capacity of 4,000 kilowatts in lieu of 5,000 kilowatts, the rated capacity of generators. The writer hoped thereby to obtain sufficiently increased economy at the lighter loads to offset the possible loss in economy due to overload. It has been shown that these 4,000-kilowatt engines are capable of carrying overloads in excess of 7,000 kilowatts. It appears, however, that it would have been a decided improvement had

larger engines been selected, conforming more nearly to the rating of the generators. Due to the use of superheated steam, high fractional load economy would have been insured, the overload capacity still further increased, and superior economy maintained at loads considerably above rating.

Having no bearing on the economy of the unit, but as a matter of particular note, the writer would state that following the acceptance test on the plant, the engine for the No. 1 unit was operated under various conditions to determine the possibilities in case of an emergency. It was shown that the unit could be operated on either one, two or three as well as four cylinders. The running conditions were smooth and the successful parallel operation of the alternators was easily accomplished under all conditions. It was further possible temporarily to overload the cylinders in use during these special trials to such an extent as to produce in the neighborhood of 1,800 kilowatts per cylinder. The time required to remove a connecting rod in case of an emergency was found to be between one and two hours. It was also found possible to operate the entire engine on one condenser as well as both condensers, causing but a slight reduction in vacuum, the second condenser being available for repairs, etc. In case of difficulty through seaweed in the circulating water the engines were often run for a long time non-condensing.

The writer believes that this type and arrangement of prime mover offers features of flexibility that merit very careful consideration and enables the maintained operation of steam power plants, under both normal and emergency conditions, with a far less percentage of reserve capacity than is permissible with any other type of prime mover. The Redondo plant is today operating without any reserve capacity whatsoever, and since the completion of the work it has regularly operated under all conditions of service desired by the management.

As the maintained economy of any type of prime mover is of great importance, the writer is able to state that the station records so far fail to indicate any considerable falling off in economy as compared with test conditions. On the other hand, it is a matter of record that a complete plant economy has been attained, since operation of plant by purchaser, exceeding that herein reported. During the dry season this year and by reason of the large overload capacity afforded by these engines, the management has been compelled and has been able to operate this station under continuous load far in excess of that for which it was designed. The engines have been operated for long periods at overloads of seventy-five per cent above the rated loads, and during such periods only a slight falling off in economy has resulted, which was less than would be expected on account of the special way in which the engines were rated.

No. 1 and No. 3 units are now being equipped with an automatic system of firing similar to that on No. 2, and it is expected that the station economy will be materially improved thereby.

COMPARISON OF ECONOMY WITH COAL-BURNING PLANTS.

For the purpose of comparing the economies herein reported with those obtained in modern coal-burning stations, the writer has given the fuel consumption reduced to the corresponding British thermal units per kilowatt-hour; these figures are possibly subject to slight error, however, by reason of oil corrections already explained.

COMPARISON WITH TURBINE PERFORMANCE.

To the writer's knowledge, the best turbine performance on the Pacific Coast based on oil fuel is considerably under that found for the Redondo plant.

When comparing these results with economies reported for eastern turbine stations the writer would call attention to the necessity of making due allowance for the variation in the initial temperature of the circulating water. The average temperature obtainable in the vicinity of Los Angeles is from sixty to seventy degrees F., as compared with circulating water temperatures in the neighborhood of the freezing point, obtainable at times in many eastern stations, this lower temperature enabling the attainment of a considerably improved vacuum. Inasmuch as the steam turbine gains largely in apparent economy, due to increase in vacuum, similar reductions should be made in the stated economy of such plants, and correspondingly in the reported fuel consumption.

The writer believes that the performance herein indicated is noteworthy and warrants on the part of designing engineers a far more careful and thorough investigation as to the capabilities of steam engines, when used as prime movers, than is manifested in the practice of late years.

Steady Flames for Atmospheric Nitrogen Extraction.

Almost the reverse of the older form of electric arc employed in the Birkeland-Eyde process of nitrogen extraction from the air, in which a high-tension, alternating-current flame is blown into a veritable disc transversely to a direct-current magnetic field, is the method used by the Badische Anilin und Soda Fabrik, which has a working agreement with the Birkeland-Eyde Company. Long, thread-like arcs are employed to oxidize the nitrogen of the air. The air is blown tangentially so as to circulate spirally around the quietly-burning arc. In some examples of this apparatus recently exhibited the tubes were of glass, coated on the inner periphery by a wire spiral, which was in metallic contact with a knob at the top of the tube. At the bottom of the tube the wire spiral is only separated by a short distance from the other electrode, which is placed in the axis of the tube. When a 3,000-volt supply is applied between the two electrodes a spark jumps across and the arc travels rapidly up the tube. If, now, air is forced in at the bottom through a number of symmetrically-placed tangential nozzles, the arc burns quietly in the axis of the tube without touching the sides, and absorbs about four amperes at 3,000 volts.

The air charged with nitrous gases which leaves the top of the tube gives up some of its heat in raising the temperature of the fresh air about to enter the tube to some 500 degrees Centigrade, and the rest is employed in steam generation. The cooled gas is then mixed with water to form nitric acid, which, after treatment with lime, results in the required manuring material. An experimental installation on these lines was opened in Christiansand (South Norway) in the spring of 1907, with a total power of 2,000 horsepower. Three ovens are at work, with a length of flame of five metres, and each absorbing 600 horsepower. Alternating current of fifty cycles is employed, and the arc burns quietly and reliably.

$6,650,000 Boston Elevated Issue.

An issue of $6,650,000 new stock by the Boston Elevated Road for the construction of the new Cambridge subway and the new elevated road from the North Station to the West Boston Bridge, has been authorized by the Railroad Commission. The stock will be sold at $110 a share.

Phoenix Glass Products.

The Phœnix Glass Company, of New York, Pittsburg and Chicago, has retained the Bureau of Illuminating Engineering, 437 Fifth Avenue, New York city, to act as consulting and designing illuminating engineers in the matter of designing or redesigning glass globes and reflectors manufactured by the company, so that beauty and utility may be blended. Albert J. Marshall, chief engineer of the bureau, will have direct supervision of this work.

As the result of this arrangement, the Phœnix company will be prepared to supply glassware for any class of service and for any illuminant, which will not only be ornamental, but will also give utilitarian results. In carrying out these ideas, the effect of light on the eye will receive very careful consideration. The Phœnix Glass Company, through the bureau, will be pleased to supply technical data regarding its product.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

AMERICAN TELEPHONE.

The report of all the Associated Bell Telephone operating companies (not including the long-distance lines) of the American Telephone and Telegraph Company for the month of October and ten months ended October 31, 1908, compares as follows:

October:	1908.	1907.
Telephone rev.	$10,261,800	$ 9,893,300
Oper. and mt. exp.	7,401,000	7,252,100
Net from oper.	$ 2,860,800	$ 2,641,200
Sundry earnings (net)	430,400	383,500
Total net	$ 3,291,200	$ 2,024,700
Interest	621,400	630,400
Balance for divs.	$ 2,669,800	$ 2,394,300
January 1 to October 31:		
Telephone rev.	$99,168,600	$93,893,000
Oper. and mt. exp.	72,515,400	69,413,400
Balance from oper.	$26,653,200	$24,479,600
Sundry earnings (net)	4,296,600	3,806,900
Total net	$30,949,800	$28,286,500
Interest	6,388,400	5,926,900
Balance for divs.	$24,561,400	$22,359,600

The maintenance charges and taxes included in the above expenses for October and ten months, compare as follows:

Month October:	1908.	1907.
Maintenance	$ 2,789,800	$ 2,715,700
Taxes	455,400	338,100
Total	$ 3,245,200	$ 3,053,800
January 1 to October 31:		
Maintenance	$27,797,400	$25,826,900
Taxes	4,285,800	3,686,500
Total	$32,983,200	$29,513,400

CHICAGO RAILWAYS.

The Chicago Railways Company reports earnings for the month of September, compared as follows:

September:	1908.	1907.
Gross	$960,567	$927,882
Expenses	788,808	618,946
Net	$171,759	$308,936

The state tax, amounting to $176,000 for the year, is included in the above expenses for 1908, against $16,000 in 1907, which was the month's proportion last year. The statement, therefore, is $160,000 better than appears.

October, November and December earnings show a better gross.

KEYSTONE TELEPHONE.

The report of the Keystone Telephone Company, of Philadelphia, for the month of November and five months ended November 30, compares as follows:

	1908.	1907.
November gross	$ 88,377	$ 88,120
Expenses and taxes	42,701	48,080
November net	$ 45,676	$ 40,040
Five months, gross	439,383	437,280
Expenses and taxes	217,455	231,811
Five months, net	$221,928	$205,469

NORTHERN OHIO TRACTION.

The report of the Northern Ohio Traction and Light Company for the month of November and eleven months ended November 30, compares as follows:

	1908.	1907.
November gross	$151,934	$146,123
Expenses	87,976	88,180
November net	$ 63,958	$ 57,943
Charges	44,012	43,351
November surplus	$ 19,946	$ 14,592
Eleven months, gross	1,731,015	1,761,196
Expenses	1,001.277	1,013,466
Eleven months, net	$729,738	$747,730
Charges	479,795	469,881
Eleven months, surplus	$249,943	$277,849

CUMBERLAND TELEPHONE.

The report of the Cumberland Telephone and Telegraph Company for the month of November and eleven months ended November 30, compares as follows:

	1908.	1907.
November gross	$ 535,062	$ 535,794
Expenses	286,931	302,041
November net	$ 248,131	$ 233,753
Charges and taxes	44,638	38,244
November surplus	$ 203,493	$ 195,509
Eleven months, gross	5,606,155	5,395,832
Expenses	3,212,414	3,307,178
Eleven months, net	$2,393,741	$2,088,654
Charges	430,896	430,918
Eleven months, surplus	$1,962,845	$1,657,736

New Monorail System.

Commissioner Bassett, of the Public Service Commission, examined on December 18 the plans of a new monorail system. They were submitted to him by the inventor, E. W. C. Kearney, engineer and managing director of the Kearney High-speed Railway Company, Limited, of London.

It is claimed that if the system were adopted it would result in the construction of subways at less than half the present cost, in absolute safety from near-end collisions, and in a large saving of time in transit.

Wireless Telegraph Rates Abroad.

The international wireless-telegraphy treaty of November 3, 1906, the supplementary agreement, the final protocol and the agreement for executing the provisions of the treaty have, up to the present time, been ratified by Germany, Belgium, Brazil, Bulgaria, Denmark, Spain, Norway, Holland, Roumania, Russia and Sweden. The treaty, the final protocol and the agreement for executing the provisions of the treaty have been ratified by Great Britain, Japan and Mexico, and recently the latter company has also ratified the supplementary agreement. Great Britain in the ratification of the treaty includes Canada, Australia, New Zealand, the Cape Colony, Natal, Transvaal, India, and all the other British colonies and protectorates, with the exception of Newfoundland and the Orange River Colony.

The American Consul-General at Berlin, A. W. Thackera, writes that the charges for wireless-telegraph messages at the German coast stations are as follows:

Besides the regular telegraph rates in Germany of five pfennigs (1.19 cents) a word, minimum price fifty pfennigs (11.9 cents), there is a charge of fifteen pfennigs (3.57 cents) a word, minimum 1.5 marks (35.7 cents), and if the message is sent to a steamer which can be reached from the coast station an additional toll of thirty-five pfennigs (8.33 cents) a word, minimum 3.5 marks (83.5 cents), is charged. These charges can be prepaid at any of the German offices.

Until the international list of wireless-telegraph stations, which is to contain the charges for sending wireless messages, is published, the fee for coast stations outside of Germany, according to information obtained from the Gesellschaft für Drahtlose Telegraphie of Berlin has been fixed at forty-eight pfennigs (11.42 cents) a word, with a minimum of 4.8 marks ($1.14).

Cleveland Tractions.

The three-cent fare in Cleveland for the six months, May 1 to November 1, produced gross earnings of $2,450,609, but a net deficit of $70,915.

The report of the three-cent fares for October will show $406,600 gross earnings, with a deficit of $29,547. This includes attorney fees of $9,000. These figures and those for November and December, which will be completed by January 15, will be considered by Judge Taylor and the receivers as their basis for deciding on the demand for an advance in fares by the stockholders.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

THE MANUFACTURE OF METALLIC LAMP FILAMENTS.

The serial article of Engineer Duschnitz, already noted in these columns, is here continued. A twisting of the filaments in a certain direction frequently takes place during the reduction process by direct current (when they are usually suspended in the reduction chamber in the form of a stirrup) and renders them unfit for use. The Auer Gesellschaft of Berlin has investigated this phenomenon and found that the twisting is due to the influence of the magnetic field of the earth, respectively of the work-room, on the filament through which direct current is flowing. This influence can be prevented by compensating the magnetic field or by magnetically screening the reduction apparatus; that is, surrounding it with iron. The latter method appears to be the most practicable. A twisted filament may be corrected by placing it in such a position that the earth's magnetism affects it in the opposite direction from that exerted in the beginning. Another and unpatented method of making this twisting absolutely impossible is to lengthen the two binding posts, from which the filament is suspended, to the right and left of the filament and line the two shanks with thorium oxide, this for the purpose of preventing the filament from becoming welded to the shanks when it is at white heat and should show a tendency to twist. A special method of glowing the filaments is employed by the Allgemeine Elektrizitaets Gesellschaft. During their reduction in hydrogen or other gases the resistance of the filaments decreases considerably, frequently to one-tenth. Thus the resistance may easily diminish so rapidly that the filament will be melted. To prevent this, the above firm uses resistances of fine iron wire (about 0.1 millimetre) enclosed in tubes filled with hydrogen, in series with the filaments. The energy becoming free on account of the gradually decreasing resistance of the filaments is taken up by these devices, so that the current flowing through the filaments cannot exceed a certain value, and the reduction apparatus can be operated without attention. The glowing is controlled at intervals, preferably by means of an ohmmeter, and continued until the resistance of the filaments has decreased to a certain definite value. Of great importance are devices for bending the filaments. These are too brittle when cold, and have to be brought at least to red heat. In free air the filaments would oxidize when heated, and the bending, therefore, has to be accomplished in a vacuum or an indifferent gas. In the method of the Auer Gesellschaft the difficulties of manipulation are very small. The arrangement consists of a tube-like vessel with a sufficiently large opening at the bottom to permit the introduction of the filaments and necessary tools and their easy manipulation, while a gas that does not affect the heated filament is made to flow through the vessel from the top and prevent the entrance of air. If a gas of low specific gravity, as hydrogen, is chosen, a current of about one litre a second is sufficient. If a heavy gas, as carbonic acid gas, is used, the vessel should be open at the top, but in this case the execution of the work will be more difficult.—*Translated and abstracted from Elektrotechnischer Anzeiger (Berlin), November 19.*

RECENT PROGRESS IN THE STUDY OF ATMOSPHERIC DISCHARGES AND LIGHTNING ARRESTERS.

The effects of excessive tensions in transmission lines due to lightning discharges have been the subject of careful study during the last few years, and the results obtained now permit a judicious choice of lightning arresters. Investigations have been made chiefly of the duration of disturbances due to a lightning discharge, of the value of the resulting tension, the maximum value of the resulting current, the normal frequency of the lightning discharge and the quantity of electricity involved in it. The duration of the disturbances was measured by recording the sparks crossing a gap placed in the circuit on a rapidly-revolving photographic plate, and the average obtained in a great number of tests was one-one-thousandth of a second; the longest noted lasted four-tenths of a second. The duration of a lightning stroke has been stated by some investigators to be as much as half a second, but there must have been an error in their observations, due to the almost simultaneous occurrence of a number of discharges. The maximum value of the over-tension in the line is evidently the result of a direct lightning discharge, and it may assume any value from zero to maximum. Observations and reasoning show that, all other things being equal, the line is subject to the highest tension at the point nearest to the inducing cloud and that it diminishes in both directions from this point. This observation demonstrates the utility of lightning arresters along the line. If the inductance of the line is such that the potential at the insulators remains at sparking value during a time equal to the dielectric retardation, the spark will jump over the insulator and pole to the ground. The discharge current can be calculated according to the usual formula: $I = V\sqrt{\frac{C}{L}}$, C and L representing capacity and inductance of the line per unit of length. This factor is of importance only in its bearing on the internal resistance of the lightning arresters, and it is sufficient to state that they are capable of withstanding an average intensity of 0.3 ampere per volt applied. The frequencies observed varied between 840 and 4,000 cycles per second, the number 3,000 being most frequently observed. In the vicinity of an inducing cloud the frequency reached 1,000,000 cycles per second. In accordance with theory, the discharge waves flow through the line the quicker, the higher the frequency. The quantity of electricity involved is determined by the application of the formula $Q = \sqrt{\frac{Jt}{R}}$, t being the duration of the discharge in a test fuse, J the energy in joules necessary to raise to its melting point one centimetre of the fuse metal, R the resistance in ohm-centimetres of this metal. By examining these results more closely with reference to the construction of protecting devices, it will be found that the characteristic elements of the latter are their sparking potential, the elements on which their discharge current depends, and the elements on which the duration of the discharge is dependent. They must, there-

fore, meet the following conditions: Their sparking tension must be lower than the voltage the insulators can safely withstand; they must have a small impedance, and they must be sufficiently strong to withstand a prolonged discharge. Of all the types of apparatus known these three requirements are best fulfilled by electrolytic lightning arresters, the construction of which is well known.—*Abstracted and translated from L'Electricien (Paris), November 21.*

THE UTILIZATION OF WIND AS A MOTIVE POWER FOR DYNAMOS.

This problem has attracted the attention of many investigators. Professor La Cour obtained the first practical results in methodical experiments carried on under the auspices of the Danish Government. The plant erected by him in 1904 at Askov has been replaced by a new and improved one. The new windmill has four wings 2.5 metres wide and 7.4 metres long. The axis of the motor is thirteen metres above ground level. The electrical installation comprises two direct-current dynamos of twelve horsepower each, and a storage battery which is charged by the dynamos and supplies current to lamps and motors. The average power obtained is twenty-one horsepower. According to Professor La Cour, the windmill with four wings is the most efficient one. The ends of the wings should turn with a velocity two-and-one-half times greater than that of the wind. The wings should be arranged at right angles to each other and should be provided with transverse adjustable sheets having an inclination of ten to twenty-five degrees. The power of this type of mill can be calculated by means of the formula: $P = \frac{Sv^3}{1{,}250}$, P being the force in horsepower, S the surface of the wings in square metres, and v the velocity of the wind in metres per second. Thus a mill with a wing surface of forty-eight square metres develops eight horsepower at a wind velocity of six metres per second, and sixteen horsepower at a wind velocity of eight metres per second, which is quite common in Denmark. A company for the atmospheric production of electrical energy has been formed in Denmark, and so far has installed some forty plants. When the storage battery is being charged and the tension of the dynamo falls below that of the battery on account of a decrease in the speed of the mill, a device known as the La Cour relay automatically interrupts the circuit to the accumulators, so that they cannot discharge through the dynamo, and closes the circuit again when the tension rises. In England W. O. Horsnail has also studied this subject. He recommends the use of a dynamo with a special winding so calculated that the tension rises only slowly under a great increase of speed. For this purpose a few turns of series winding in a direction opposite to that of the shunt winding may be used. The Oerlikon Company, of Switzerland, has likewise occupied itself with the practical solution of this problem, and has devised a system of connections which makes the operation of the plant entirely automatic, and supervision unnecessary.—*Translated and abstracted from L'Electricien (Paris), November 28.*

THE PRESENT POSITION OF THE VARIOUS TYPES OF INCANDESCENT LAMPS.

Prof. W. Wedding has recently carried out an exhaustive test at Charlottenburg on some 200 lamps of metallized-carbon, tantalum and tungsten-filament types. The lamps were suspended vertically from wall brackets, and vibration avoided as far as possible. Most of the light measurements were made in an Ulbricht globe photometer, one metre in diameter. The accompanying table gives some of the results of these tests, the figures for each group of similar lamps of the same make being averaged.

		Candlepower at Start.		Useful Life in Hours.	Average Watt Consumption.
		Horizontal Hefner C. P.	Spherical Hefner C. P.		
Metallized carbon filament		16.8	13.34	322*	34.2
		52.9	40.2	434	100.7
		24.3	17.8	733	54.7
Tantalum filament.		15.1	11.6	867	27.3
		23.1	17.5	1,552	41.4
		51.0	38.4	1,685	85.7
Tungsten filament	No. 1	26.3	20.0	1,651	27.8
	3	27.9	20.3	665	31.0
	6	28.5	22.8	1,819	36.0
	7	30.3	21.0	669	50.7
	9	35.3	28.7	1,217	38.9
	11	37.5	28.2	1,492	38.5
	14	54.2	40.8	1,014	61.1
	15	54.3	41.2	756	60.2
	16	55.8	44.5	1,111	66.9
	20	99.8	79.2	1,766	110.5
	21	116.5	97.5	413	124.1

*This short life is partly due to the lamps being 107-volt ones run on a 110-volt circuit.

The useful life of the lamp, given in Column 4, is taken to be the number of hours in which the candlepower falls off by twenty per cent, where such a falling off takes place; but where, as in the case of most of the tungsten lamps, this twenty-per-cent reduction is practically never reached, the useful life is taken as the average number of hours, after which the filaments broke and could not be made to connect again. Taking the normal tantalum or carbon lamp as a sixteen-candlepower unit, and the normal tungsten lamp as a twenty-five-candlepower unit, the average consumptions are 34.2 watts, 27.3 watts and thirty-two watts, respectively, in the three classes; or, for lamps of equal candlepower (twenty-five) the figures are 54.7, 41.4 and thirty-two watts.—*Abstracted from the Electrical Review (London), November 27.*

THE CONDENSER EFFECT OF THE TELEPHONE AND MEANS FOR ELIMINATING IT.

When over-tensions occur in telephone lines, says Prof. W. Peukert in this article, a current passes through the human body, for the telephone must act as a condenser, the copper wire winding forming one of its armatures, the human body the other, and the hard rubber casing of the telephone the dielectric. He has demonstrated his theory by experiments and measurements. Over-tensions in telephone circuits are of frequent occurrence, their chief causes being atmospheric conditions and the presence of high-tension lines, and the current caused to flow through the body might be detrimental to the health of sensitive persons who frequently use the telephone. The effect may be diminished by establishing a special earth connection through a condenser, or by decreasing the capacity of the condenser formed by the telephone and the body. The protection afforded by the former method will be the greater the larger the capacity of the condenser, as the current flowing through the body will then be smaller. This may be done by surrounding the telephone receiver with a metal layer and connecting the same to the ground. The same protection will be afforded by connecting two condensers in series with the binding posts of the telephone and grounding them. A still greater safety will be attained if grounded condensers are also connected to the secondary coil of the microphone transformer. The other method of decreasing the condenser effect is to insulate the human body from the ground. In this case two condensers—telephone and human body, human body and ground—are connected in series, and the current flowing through them is diminished. Both methods may be used in conjunction, but by none of them can the condenser effect be eliminated entirely; it can only be decreased to a certain degree. —*Translated and abstracted from Electrotechnische Zeitschrift (Berlin), November 26.*

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Paiste Pipe Taplets.

The H. T. Paiste Company, Philadelphia, Pa., has developed an entirely new line of conduit fittings, which has been

TYPE "C"—ONE-HALF-INCH CONDUIT.

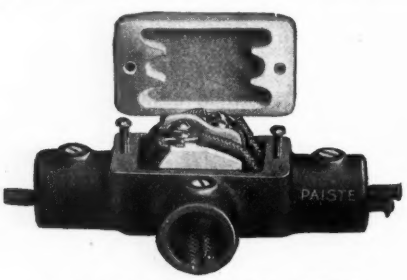
trade-marked "Pipe Taplets." This line has been designed so as to greatly simplify the work of the wireman, and to carry out the idea of uniformity as far as possible.

TYPE "T"—ONE-HALF-INCH CONDUIT.

The taplets are uniform, not only with respect to all covers and fittings, but also with all styles of Fielding molding, receptacles and rosettes which are now in

ELBOW FOR ONE-HALF-INCH CONDUIT.

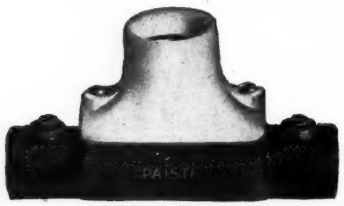
daily use, and which are carried in stock by supply men. The pipe taplets are designed with an opening of such shape that the Fieldings can be used, and this common opening applies to the several types for one-half-inch, three-quarters-inch and one-inch conduit.



PIPE TAPLET AND TAP WIRED.

The pipe taplet is attached to the conduit by pipe threads located inside the sleeve. There is also a set-screw method of adjusting which enables a line-up of absolute trueness.

The taplets are made in several types, Type C being for use where the lines run straight through; Type E, the end fitting; Type A, for making an end drop; Type



TYPE "C" WITH NO. 50,724 FITTING.

B, a side drop, and Type T, for making a branch. In the elbow fitting, however, an entirely new type has been devised. This elbow can be used not only for making a short right-angled turn, but more particularly for a pull outlet. The opening is placed on the outside of the bend,

TWO-HOLE PORCELAIN COVER.

and all inside lines are easy curves with smooth surfaces. This design is such that the wires can be pulled straight through, and then fed through the other arm without abrasion or other injury. The elbows are galvanized inside and cut, and are always furnished with necessary

TEN-AMPERE SWITCH ATTACHED TO PIPE TAPLET.

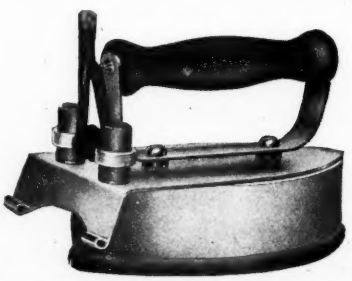
soft-rubber gaskets and plain steel covers.

In using these pipe taplets with the standard Fielding receptacles and rosettes, the Fieldings are wired just as is usual with molding. The button part rests on the two inwardly-projecting lugs in the pipe-taplet opening, and the wires are looped up and set under the receptacle set-screws, and the cover fastened on with two brass screws, provided with each pipe taplet.

An additional fitting has been designed that will take care of all types of pipe taplets and snap-switches. This switch fitting is attached to the pipe taplet with long brass screws. A loose yoke piece is fastened loosely to the switch. The switch is set down on the fitting so that this loosely-hanging yoke-piece slips through the rectangular recess, and the whole is turned so that the handle of the switch is square with the pipe taplet. By tightening up the two screws that hold the switch to the yoke, the whole is securely fastened.

The Watson Economical Electric Flat-Iron.

A radical departure from the general type of electric flatiron has been made by the W. N. Durant Company, of Milwaukee, Wis., in its Watson iron, for which much greater efficiency as well as durability is claimed. Instead of using a resistance heating-unit, the iron is used exclusively on alternating-current circuits and employs simply a magnetic coil of fireproof wire embedded in a casting of proper material. The heat is developed



THE WATSON ELECTRIC FLATIRON.

by hysteresis in the entire casting body, and, as no part is ever hotter than the working surface, all danger of burning out is entirely eliminated.

A still greater advantage claimed for this iron is its economy in consumption of current. The six-pound iron, which is the most popular size, consumes less than 450 watts under working conditions, and the seven-and-one-half-pound very little more. Furthermore, the device is so insulated as to have a large heat-storage

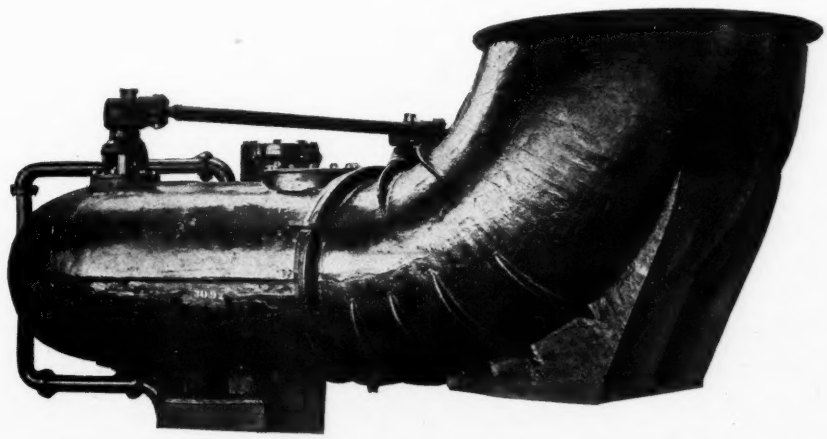
capacity, and will retain an ironing temperature for a considerable time after disconnection. But four minutes is required to bring the iron to a working heat distributed evenly over the entire bottom surface.

Another distinctive feature is the shape of the iron, which is double-pointed. Practically all the range sadirons in use today are pointed at the back as well as front for the proper handling of fancy articles. The Watson iron, however, is the only electric flatiron which does not have to go back to the old square end in order to accommodate a resistance unit. Owing to the nicety of adjustment possible in the size of the magnetic coil, these irons can be furnished accurately tested out for any circuit from 100 to 120 volts of any frequency. No harm, however, can result from subjecting them to an overload of fifteen per cent.

The handle, connections and finish are very durable and will retain their good appearance through considerable usage. The terminals are a special feature and are provided with a flexible cord so connected that it will not kink or wear. The terminal plug is easily slipped off or on to break or make connection directly back of the handle.

Hydraulic Turbine for Nelson, B. C.

The accompanying illustration shows a 1,250-horsepower hydraulic turbine in course of construction at the Scranton works of the Allis-Chalmers Company.



TWELVE-HUNDRED-AND-FIFTY-HORSEPOWER SINGLE TURBINE FOR THE CITY OF NELSON, B. C.

This turbine has now been installed at the power house of the city of Nelson, B. C.

The turbine and vertical alternator are both of Allis-Chalmers Company's standard design, and, after extensive tests in service, were found to be even more efficient than was claimed for them by the builders. The turbo-generator has a normal capacity of 750 kilowatts, but during the test run, at which the city officials of Nelson were present, this output was increased to 1,340 kilowatts for a period of over forty-five minutes' continuous running, without undue increase in temperature of bearings.

Up to the time of installing this unit the lighting and power loads for the city had been supplied by the West Kootenay Power and Light Company, situated just across the Kootenay River from the new city power plant, the river being the source from which both plants derive power.

The Industrial Instrument Company.

The Industrial Instrument Company was organized by men who have long been engaged in the manufacture of measuring instruments, the leaders being B. B. Bristol, E. H. Bristol and W. E. Goodyear, all of Waterbury, Conn., who were for many years active in the development of the Bristol Company.

The Messrs. Bristol, who were among the original incorporators of the Bristol Company, with several of their co-workers, withdrew from that company last spring, to develop a plan that involves the development of an extensive line of those types of measuring instruments and apparatus, the use of which promotes, directly or indirectly, safety and economy of operation in industrial plants, and oftentimes makes possible operations which, without such instruments or apparatus, would be impossible. It is proposed to concentrate all energies in the development and sale of a harmonious line of apparatus for this one broad economic field.

This plan presents many advantages from the customer's standpoint, in that he is able to secure a certain distinct class of apparatus from one house, knowing that the component parts will harmonize, and that he has obtained a well co-ordinated equipment designed to accomplish a certain result. He is relieved of the inconvenience of securing parts of an equipment from different makers and of the responsibility and forethought necessary to insure their successful operation as a whole.

From the vendor's standpoint, it is, of course, an advantage to have a certain class of customers, whose problems it is possible to study, so that their peculiar requirements in a certain direction may be met to a nicety.

Lastly, manufacturers' efficiency is attained through the use of the same equipment for the production of several closely related articles, rather than the employment of different equipment for each.

The Industrial Instrument Company is a Connecticut corporation, with authorized capital stock of $2,000,000. This company now owns the entire capital stock of the Standard Gauge Manufacturing Company, until recently of Syracuse, N. Y., and of the Standard Electric Time Company, of Waterbury, Conn.

The Standard Gauge Manufacturing Company will be reincorporated in Connecticut. It has purchased a plant at Foxboro, Mass., into which it has moved from its outgrown quarters at Syracuse. The personnel of the organization includes instrument engineers of long experience, so that its engineering staff is capable of meeting successfully demands for apparatus of a special nature for particular conditions, so long as it falls within the company's scope. This engineering staff will continually be engaged in the development of those types of instruments necessary to complete the line planned by it.

The sales end of the business will be carried on by the Industrial Instrument Company, of New York, which has recently been formed for this purpose. This company will handle the entire output of the Standard Gauge Manufacturing Company, and also the industrial branch of the business of the Standard Electric Time Company.

The officers are: President, Bennett B. Bristol, formerly secretary and treasurer of the Bristol Company; vice-president, Walter W. Patrick, until recently manager of the New York office of the Bristol

Company; secretary, Henry P. Dennis, formerly manager of the Chicago office of the Bristol Company; treasurer, Arthur F. Mundy, secretary and general manager of the Standard Gauge Manufacturing Company.

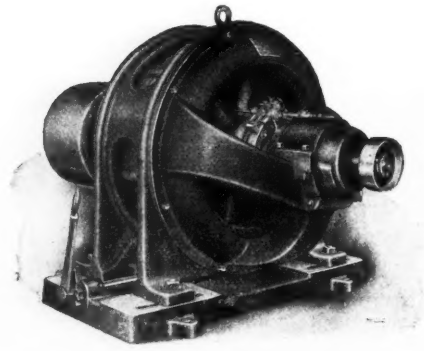
It is the intention of the company to place on the market instruments as fast as they can be perfected and developed to a point where they can be considered worthy of the confidence and support of the engineering world.

The home office will be located at Foxboro, Mass., with sales offices at 50 Church Street, Hudson Terminal, New York, and 752 Monadnock Building, Chicago.

A New Line of Belt-Driven Alternators.

A new line of polyphase belt-driven alternators, known as Form PB, has been developed by the General Electric Company, Schenectady, N. Y., for use in small generating plants and in isolated lighting and power plants, where rapidly increasing inductive loads and consequently low power-factors are encountered. Designed for eighty per cent power-factor service, they will operate, however, with equal success on higher power-factor service.

The Form PB generators, shown in the accompanying illustrations, are arranged for belt drive, and are furnished with pulley and sub-base, the sub-base being provided with a ratchet screw or belt-tightening device. Although it is customary to supply these generators as belted units, they are readily adapted for direct connection to water-wheels by omitting the driving pulley and sub-base and adding a coupling. All generators have on the end opposite the driving end a shaft extension to receive the exciter driving pulley.



FORM PB BELT-DRIVEN ALTERNATOR.

STATOR WINDING AND FRAME.

The armature frame is of rugged construction, so proportioned as to give maximum strength and rigidity with a light and compact structure. Ventilating openings are provided, which allow a free circulation of air around the ends of the windings and through ducts in the laminated core. The armature coils are form-wound, thus allowing a damaged coil to be readily replaced, if necessary.

The field structure consists of laminated pole-pieces dovetailed into a laminated iron spider. The punchings are carefully stacked and riveted together, forming a rotor that will safely withstand high speeds.

Two methods of building the field coil for revolving-field machines are used. For the fifty-kilowatt and seventy-five-kilowatt sizes the wire is wound on spools, which are slipped over the pole-pieces and held in place by the enlarged pole-tips. In the larger sizes, the field coils consist of a single strip of flat copper wound on edge, so that one surface of every turn is exposed to the air. This construction permits thorough and efficient insulation between each turn and insures a low temperature in operation.

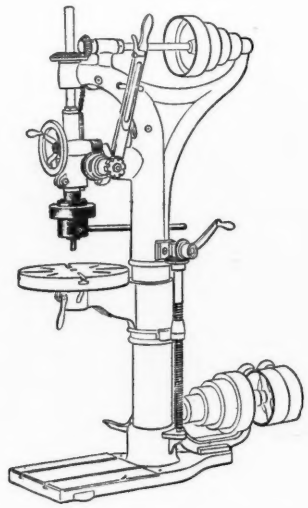
The collector rings for the field are mounted on insulating bushings, located on the shaft, and are exposed to the air on all sides. Two or more carbon brushes are provided for each ring, and no attention is required during operation.

As noted before, these generators have been especially designed for use in isolated plants where mixed lighting and motor loads are the rule rather than the exception. It is practically impossible in such cases to obtain good voltage regulation by hand control, and some form of automatic voltage regulator must be used. For this service the well-known TA regulator, manufactured by the General Electric Company, is recommended. When used in connection with the exciters for the PB alternators, this automatically maintains practically constant voltage at the bus-bars or at the center of distribution, according to adjustment. The exciters have a normal voltage of 125 volts, but are capable of delivering 150 volts continuously. This margin of power enables them to overcome easily the demagnetizing effect of the armature current on circuits of low power-factor.

When intended for operation as synchronous motors, Form PB generators are equipped with an amortisseur or squirrel-cage winding, located in the revolving-field pole-pieces, this winding giving ample starting torque with very low value of starting current. The winding does not in the least affect the operation of the machine as a generator. These generators are at present available with either two or three phase windings and for operation at 240, 480, 600, 1,150 and 2,300 volts. The overload ratings and temperature guarantees are conservative and in accordance with the best engineering practice.

A Triangular Bit for Boring Square Holes.

The problem of boring square holes, or holes of other shapes than round, has long attracted inventors, and is, moreover, of considerable practical interest in view of the wide use of such holes for counter-



TRIANGULAR BIT AND GUIDES SET UP IN SINGLE-SPINDLE DRILL.

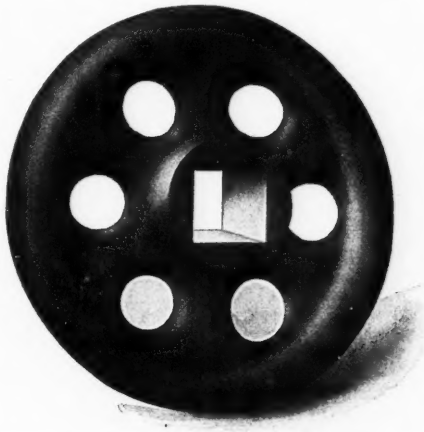
sinking and for keys, wrenches, spanners, hand-wheels, and similar articles. The present methods of making square holes (outside of punching and casting), such as first boring round holes and then working them up by hand or by means of a

slotter or shaper, are laborious, expensive and slow.

The machine to be described, however, bores square holes with the same facility and with nearly the same speed that the ordinary twist or flat drill will bore a round hole in the same material. At the same time the tool, while not altogether as simple as the flat drill, is not complicated nor expensive, and is easily made or ground in the average machine shop. The only appliance needed for the use of this special tool upon such machines as lathes, drill presses and milling machines, is a special chuck, which constitutes its principal interest from a mechanical standpoint, and which we shall now proceed to describe.

The chuck is really a device of making the three-cornered boring tool or bit travel about in such a way as to strike out a square hole in the work. It consists of a driving part, which is screwed onto the spindle of the machine, a guiding part, which either rides upon the first part, or else is secured permanently to the frame of the machine, and a third part, or socket, into which the shank of the drill is screwed. This third part is caused to rotate by the first part, but has a slight freedom of motion in relation thereto, being guided as to its exact movements by the matrix or frame in the stationary part. Where square holes are to be drilled, the shank of the tool is three-cornered, the sides of the shank being formed by segments of circles struck from opposite corners as centers, the radius of these circles to the radius by which the circles used for striking out the sides of the shank are formed.

In boring, when one of the sides of the shank is either rolling or sliding upon one of the sides of the square guide, the opposite corner of the shank will be moving in a straight line in contact with the opposite side of the guide. The corresponding corner of the head of the tool would at the same time strike out a straight line in the work. This motion takes place on all four sides of the guide, except for a little space at each corner,

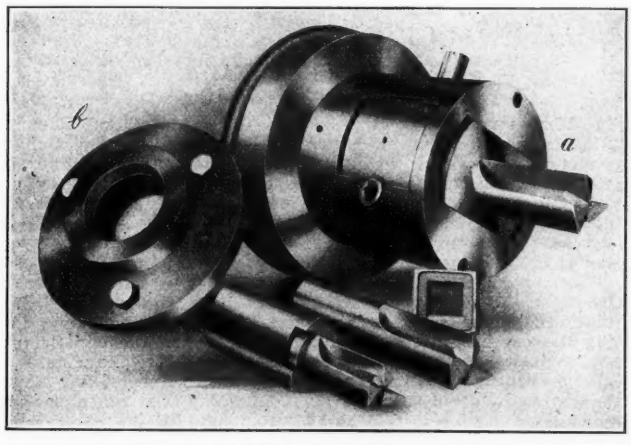


NATURE OF CUT MADE WITH ANGULAR BIT.

the result being that the hole is perfectly square except for a slight rounding at the corners. If it is desired to bore out a complete square with sharp corners, a special tool is employed, having a shank being the same and equal to one of the sides of the square hole which is to be drilled. The guide in the stationary part of the chuck is adjusted to the size of the hole to be drilled, that is, so that the sides of the square opening are just equal considerably larger than the head of the tool, one corner of the shank being rounded instead of angular. The exact form of this round-cornered shank has been worked out empirically, and a complete set of templets made for the different sizes of tools apt to be required in actual practice. The tools for both the round-cornered and sharp-cornered squares can be ground by means of a special attachment to the ordinary grinding machine.

The accompanying illustrations show the arrangement of the special chuck for handling the triangular bit. As is clearly displayed in the first of these views the chuck can be inserted in the stock of a standard single-spindle drill.

This device has recently been put on the market in Germany, where a large number of chucks are in use in the shops of such firms as Friedrich Krupp, Siemens & Halske, etc. It is being introduced in this country by the Radical Angular Drill Company, having offices and showrooms at 114 Liberty Street, New York city, where the machine and samples of its work are now on exhibition.

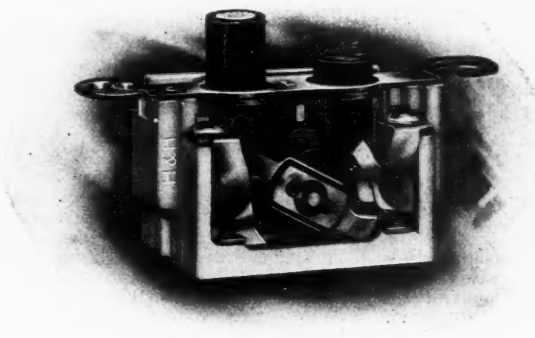


TRIANGULAR BIT AND CHUCK.

The H. & H. Shallow Push-Switch.

The accompanying illustrations show the shallow push-switch which has been placed upon the market by the Hart & Hegeman Manufacturing Company, Hartford, Conn. This is made single-pole for ten and five amperes, 125 and 250 volts; in double-pole, ten amperes, 250 volts; in three-way, ten and five amperes, 125 and 250 volts, and in four-way, five and two amperes, 125 and 250 volts.

This shallow push-switch has been developed to meet the demand for a push-switch for shallow partitions, and in order to allow more room for wires in the regular box. Exhaustive tests on the new switch have been made, and the company is confident that the operation of this switch will substantiate its claims for excellence and fitness for the service intended.



H. & H. SHALLOW PUSH-SWITCH.

Current Electrical News

CONTINENTAL EUROPE.

(Special Correspondence.)

PARIS, DECEMBER 14.—Among the new companies which have been formed in France, I note the Gas and Electric Company, of Villeneuve, which has its headquarters at Paris; Costier et Cie., which is formed for the manufacture of lamp bulbs, also at Paris; Hamille et Cie., an accumulator manufacturing company, at Neuilly, in the suburbs of Paris, also the Compagnie de l'Energie Electrique de l'Aube, at Troyes, and the Société Electrique de la Barousse, which is located at Toulouse. A large company has been formed at Lille, France, known as the Compagnie Generale Boulonnaise d'Electricité.

The report of the Energie Electrique Company for the last fiscal year showed a prosperous state of affairs. This company owns the large system of hydraulic plants and network of power lines in the Mediterranean Alps region, which supplies current for Nice, Monte Carlo, Toulon and Marseilles. The report showed receipts $362,000, which is $47,000 above last year's showing, and expenses $157,000, or $18,000 in excess of last year. The profits for the year are, therefore, $205,000.

Among the recent electric-lighting and power projects in France it may be noted that the municipality of Sainte-Florine has received a proposition for a current supply to be taken from a central station located in the region at Lenyts. The municipality of Nuits-St. Georges will probably adopt an electric-lighting project, which has been presented to it by M. Sarazin. A new company has been formed in the town of Buironfosse, Alsace, in order to secure a power supply for this locality and others in the same region. At Onnaing the rights for the electric-lighting supply have been obtained by M. Vinker.

The main work of the recent telegraphic congress held at Lisbon has been the revision of the international telegraphic regulations, which form part of the St. Petersburg telegraph convention. There has been recently published the revised text of the telegraph regulations, together with the international rates, both European and extra-European, also the present rates of the different cable companies.

The Industrial Society of Mulhausen, Alsace, is to award a number of medals and other prizes for its annual concourse of next year. One of the points relates to a new type of boiler, which must have been in regular working in Alsace for one year past. There is also a medal awarded for a self-stoking boiler, which uses the fuel prevailing in the country. A prize is to be given for a totalizing indicator of the work of a steam engine, also for a producer or blast-furnace gas engine, of at least 250 horsepower, which has advantages over a steam engine. Among the other subjects are a gas producer, an improved smoke consumer, and a mechanical conveyor for furnace slag.

Among the new radio-telegraphic stations may be noted the connection which has lately been opened up between Zanzibar and the Pemba Island.

It is stated that the Siemens-Schuckert electric firm of Germany will go into the manufacture of airships, and is to erect a large factory for this purpose at Nauen. A. DE C.

GREAT BRITAIN.

(Special Correspondence.)

LONDON, DECEMBER 12.—The Post Office authorities have granted licenses for the erection of a number of exchanges in connection with the employment of what is now called the "telewriter," or more familiarly Ritchie's telautograph, which was brought to the public notice here some years ago. The appliance operates to reproduce writing or drawings directly, in the same way that messages can be sent over the telephone. The apparatus has already a fair use in business houses and the idea is to set up exchanges and canvass for subscribers precisely on the lines of a telephone business, royalties being paid to the government for the facilities thus afforded and for the necessary wayleaves.

The Board of Trade has caused a little stir in municipal circles in Bath by prohibiting the sale of the local electrical undertaking to a private company. Curiously enough the Bath undertaking was originally commenced by a company and was purchased by the municipality. Now the latter cannot make it pay and has proposed to transfer it to another company in perpetuity, at a price some $200,000 above the cost to the city. To this, the Board of Trade has refused to consent, holding that it is improper that the undertaking should be burdened with the extra price for a plant which is already eleven years old. It also appears that under the Electric Lighting Acts a local authority cannot lease its electrical powers in perpetuity.

When both the Light Railways and Tramways Association and the Municipal Tramways Association appointed committees to investigate the brake question, the Board of Trade endeavored to bring about a fusion of the two committees and thus avoid the preparation and publication of two reports on the same subject. The two bodies, however, could not come to an agreement and so the investigations went on independently, there being at the same time a little friction, with the result that certain members of the former body resigned. The Tramways and Light Railways Association issued its report a short while ago, and it was duly noted at the time. The second report has now been issued and it arrives at more or less the same conclusions. The chief point, however, is the emphasis placed upon the need for keeping the rails clear of grease. The committee reports in favor of a brake which can be applied either by hand or power by a single lever to both rails and wheels, and reports against having a brake purely for emergency purposes. G.

EASTERN CANADA.

(Special Correspondence.)

OTTAWA, DECEMBER 19.—At a meeting of the City Council of Windsor, Ont., for further consideration of the Niagara power scheme of the local government, 1,200 horsepower was fixed on as the amount that the city will be able to use.

The City Council of Brantford, Ont., has asked the Street Railway Company to put up a guarantee of $25,000 that the present lines will be rebuilt within one year and an extension made within two years, before a renewal of the franchise will be granted. The company's rights have lapsed owing to failure to make the improvements as promised by the company.

The Ontario Power Company, of Niagara Falls, is preparing plans for the construction of a new pipe line to increase its capacity of electric power by 65,000 horsepower. The work will be commenced early in the coming spring. This work is made necessary in order to handle the contract with the Hydro-Electric Commission of Ontario. The tunnel will be of steel, lined with concrete, and will be thirty feet in diameter and upward of one mile in length. The work will cost about $750,000 and when completed the company will be able to develop 180,000 horsepower.

A conference of the municipalities of the southwestern peninsula of Ontario was recently held at Windsor to hear Hon. Adam Beck, chairman of the Hydro-Electric Commission, explain the government's Niagara power scheme. At least seventeen municipalities will vote on the electric power by-law on January 4. With the taking of 5,000 horsepower, or more, an estimate was given at $34.90 per horsepower. W.

WESTERN CANADA.

(Special Correspondence.)

WINNIPEG, DECEMBER 19.—The City Council of Edmonton, Alberta, has decided to double the equipment of the municipal street-railway system which operates in Edmonton and the sister city of Strathcona. So far the system has proved a very great success and it is apparent the venture will be as profitable financially as the other public utilities owned by the city.

At the recent municipal elections held in Winnipeg two of the candidates were pledged for the immediate completion of the civic power plant at Point du Bois; the third candidate was opposed to the civic power development, one of the planks of his platform calling for the abandonment of the scheme and favoring the purchase of power from the Winnipeg Electric Company. Approximately 11,000 votes were cast for the three candidates, the anti-power man getting but 129 of that number. W. Sanford Evans was elected over R. A. C. Manning, the other pro-power candidate. The result of the election assures the early completion of the plant, for which tenders are now being called.

The Regina Interurban Tramway Company is the name of a new company seeking incorporation under the laws of the Province of Saskatchewan for the purpose of building electric car lines from Regina to adjacent towns.

At the coming municipal elections at Port Arthur, Ont., the rate-payers will vote on a plebiscite to decide whether the electrical interests owned by the city shall continue in charge of the commissioners or whether an independent board of experts, removed from ward influences, shall be appointed. Among other public utilities the city operates the electric-lighting plant, tele-

phone system and that portion of the street-railway system running in the city limits. J. J. Carrick is mayor.

At the next meeting of the City Council of Calgary, Alberta, Alderman Watson will introduce a motion providing for a sufficient sum of money being set aside for preliminary surveys and estimates for the proposed development of civic power at some site near Calgary, which is yet to be selected.

R. H. Sperling, general superintendent of the British Columbia Electric Street Railroad Company, with headquarters at Vancouver, British Columbia, announces the company is willing to build a line through the municipality of Port Grey providing the company can make a satisfactory arrangement with the authorities.

An official of the Canadian Pacific Railroad Company denies the reports published in a number of daily papers to the effect that the company will at once arrange for the electrification of certain lines in southern British Columbia. He admits the company is always ready to consider any proposition for the reduction of operation expenses, but says the electrification scheme for British Columbia has not been given serious thought as yet.

The Sunny Hill Rural Telephone Company has been incorporated under the laws of Saskatchewan to build a rural telephone system. Address E. J. Wright, Regina, Saskatchewan.

At Dundurn, Saskatchewan, the Dundurn Rural Telephone Company has been incorporated to build several farmers' telephone lines.

The municipal authorities at Birtle, Man., have ordered the instruments for a telephone system and a line is now being built to Solsgirth. Farmers living en route will be connected with the telephone system if they so desire. Address T. W. Thompson.

A company is being formed at Estevan, Sask., to build a telephone line to the Hamar and Ambrose districts. Address H. Yardley, Estevan.

Efforts are being made at Killam, Alb., to organize a company to build a telephone line to the farming districts to the south of that town. Address J. A. Neely, at Killam.

The $350,000 capital of the Regina Interurban Tramway Company, now seeking incorporation with head office at Regina, Sask., has already been subscribed. The company proposes to build a line from Regina to Long Lake and from that point to circle the city. The incorporators are: J. L. R. Parsons, R. R. Barber, C. J. Harris, W. M. Logan, J. F. Frame and J. H. Housser. R.

IMPORTANT DEVELOPMENTS.

(Special Correspondence.)

PENNSYLVANIA PREPARES FOR MAIN LINE ELECTRIFICATION—Estimates for about $5,000,000 of work along the main line of the Pennsylvania have been asked. The contract to be let will include damming the Juniata River, cutting away part of the mountain to eliminate a big curve and grade and erecting an immense power plant near Lewistown. That this is the first step by the Pennsylvania toward the electrification of the main line is believed generally.

NORTHERN PACIFIC CONSIDERS ELECTRIFICATION OF MOUNTAIN SECTION—Engineers representing the motor-power department of the Northern Pacific Railroad have been in Livingston, Mont., working on a plan to use electricity in carrying trains over the mountains just west of the city. It is stated that the proposition is being investigated and that at an early day electric power is likely to be used in pulling both passenger and freight trains over the mountains. If the plan is adopted the company will construct a large power plant at some point on the Yellowstone River.

ILLINOIS TUNNEL COMPANY WOULD SELL ITS TELEPHONE FRANCHISE TO CHICAGO TELEPHONE COMPANY—Representatives of the Illinois Tunnel Company, which operates the freight tunnels under the city of Chicago and also controls a telephone franchise, serving buildings reached by its tunnels with an automatic telephone service, have appeared before the City Council asking permission to sell its telephone franchise and plant to the Chicago Telephone Company. In accordance with the terms of its contract with the city, the tunnel company will lose its franchise February 8 unless the 20,000 telephones stipulated are installed by that time. Its present subscribers do not total more than one-quarter of this number. The members of the Council have not been disposed to decide upon giving the permission offhand, and have taken the matter under consideration. If, as the Independent telephone interests hope, they are successful in getting into Chicago for toll-line connections or for a city exchange, the present lines of the tunnel company could be used by them to good advantage.

OBITUARY.

MR. C. A. DERTSLER, engineer for the British Columbia Electric Street Railroad Company, was drowned while crossing the Vedder River near Chilliwac, B. C., on a raft. The raft struck a rock in mid-stream and was dashed to pieces. R.

NEW MANUFACTURING COMPANIES.

RACINE, WIS.—The Racine Electrical Manufacturing Company has been incorporated with a capital stock of $25,000.

DENVER, COLO.—The capital stock of the Silver State Electric Company has been filed at $50,000. The incorporators are R. S. Willoughby and M. T. Weber of Denver.

PORTLAND, ME.—The Pemigewasset Electric Company of Portland, general electrical merchandise dealers, has been capitalized at $150,000 by A. G. McPhierson, J. R. Parsons and W. M. Bradley.

FORT SMITH, ARK.—The Pittsburg Supply Company has been incorporated with a capital stock of $50,000 by E. C. Lichty, J. B. Weatherton and P. C. Hendricks, to manufacture electrical supplies and fixtures.

CHICAGO, ILL.—The Electromagnetic Tool Company, organized with a capital of $50,000, has been incorporated by O. R. Barnett, P. H. Truman and L. H. Peck, to manufacture electrical and electromechanical devices.

NEW YORK, N. Y.—The Hardt Electric Company, Manhattan, incorporated for the purpose of manufacturing electrical appliances, with a capital of $50,000, has been formed by R. M. Patterson, G. Link, Jr., and C. Rush, New York city.

NEW YORK, N. Y.—The Monarch Storage Battery Company, of New York city, has been incorporated with a capital stock of $50,000 to manufacture electrical and mechanical appliances. The incorporators are headed by Alexander D. Thornburn, of New York.

CHICAGO, ILL.—The Chicago Engineering and Inspection Company has been incorporated with a capital stock of $2,500 to do a general engineering, electrical and construction business. G. M. Proudfoot, A. R. Leland and J. H. Westover are members of the company.

BROOKLYN, N. Y.—The Borough Gas and Electric Fixture Company, of Brooklyn, has been chartered with a capital of $25,000. The directors are: S. J. Miller, Jennie Miller, A. B. Cohen, Louis Halpert, George Bauer, Hyman Kagel and Bernard Rathberg, of Brooklyn.

BOSTON, MASS.—The National Electric Manufacturing Company of Boston has been incorporated to manufacture and sell electrical apparatus. Its capital is placed at $50,000 and its officers are: President, Starbuck Sprague, No. 21 Bromfield Street; treasurer and clerk, Charles H. Sprague, No. 15 Beacon Street.

DULUTH, MINN.—The Richardson Electric Company has been organized under the revised laws of 1905 of Minnesota, to buy, sell, manufacture, install and deal in electrical apparatus, appliances, machinery, fixtures and supplies of every kind, and to engage in all branches of electrical engineering and construction work for light, heat, power and all other purposes, and to manufacture, purchase, supply, sell and deal in electricity and electric power; also to engage in the manufacture, engineering, construction and equipment of telephone, telegraph, heating, lighting, plumbing, ventilating, electrical and mechanical systems. The incorporators are William P. Bear, Frank Windblade, Axel W. Lindgren, Walter L. Seaton, all of Duluth. The first board of directors is as follows: William P. Bear, president; Frank Windblade, secretary and treasurer; Axel W. Lindgren, vice-president. The capital stock is $50,000, divided into 1,000 shares of $50 each.

NEW PUBLICATIONS.

THE MINNESOTA ENGINEER—The November issue of the quarterly published by the Engineers' Society of the University of Minnesota contains a detailed description of the Hatfield hydroelectric plant of the La Crosse (Wis.) Water Power Company, by Albert J. Hitzker, a senior in the school of electrical engineering.

NAVY DEPARTMENT ANNUALS—The following publications for the fiscal year 1908 have been received from the Navy Department Library: Annual report of the Superintendent of Library and Naval War Records to the Secretary of the Navy; annual report of the Chief of the Bureau of Equipment; annual report of the Chief of the Bureau of Yards and Docks; annual report of the Chief of the Bureau of Ordnance.

CHEMICAL ANALYSES OF COAL—In behalf of the United States Government, which is a large user of coal, the United States Geological Survey in 1907 made a thorough investigation of the Pocahontas and New River coals. The tests were conducted at the Government plant on the grounds of the Jamestown Exposition, near Norfolk, Va., and their especial purpose was to determine the best methods of using the coals economically. The results of these tests are published as Bulletin 362 of the United States Geological Survey, in a pamphlet by John Shober Burrows, entitled "Mine Sampling and Chemical Analyses of Coals Tested at the United States Fuel-Testing Plant, Norfolk, Va., in 1907."

ELECTRICAL SECURITIES.

Generally downward price movements, with an irregular market, were the prevailing speculative and investment conditions last week. Not since election has there been heard so much complaint of the recent advance in prices having discounted growing improvement in trade. The necessity of meeting large end-of-the-year disbursements has caused some anxiety and this has probably had a considerably depressing effect upon optimism. Railroads continue to report improving returns with advances in net well sustained.

Dividends have been declared upon the following electrical securities: Electric Storage Battery Company; regular quarterly dividends of three-fourths of one per cent on the common stock and three-fourths of one per cent on the preferred stock, payable January 2 to stock of record December 23. Cincinnati Gas and Electric Company; regular quarterly dividend of one-and-one-eighth per cent, payable January 1. Cincinnati Street Railway Company; regular quarterly dividend of one-and-one-half per cent, payable January 1. Nebraska Telephone Company; regular quarterly dividend of one-and-one-half per cent, payable January 10 to stock of record December 31. Cumberland Telephone and Telegraph Company; regular quarterly dividend of two per cent, payable January 1 to stock of record December 20. Bell Telephone Company of Canada; regular quarterly dividend of two per cent, payable January 15 to stock of record December 24. American Telephone and Telegraph Company; regular quarterly dividend of two per cent, payable January 15 to stock of record December 31. Tri-City Railway and Light Company; regular quarterly dividend of oneand-one-half per cent on the preferred stock, payable January 2 to stock of record December 22. American Cities Railway and Light Company; regular quarterly dividend of one-and-one-half per cent on the preferred stock, payable January 1 to stock of record December 21. Massachusetts Lighting Companies; regular quarterly dvidend of one-and-one-half per cent, payable January 15 to stock of record January 1. Boston and Worcester Electric Companies; $1 per share on the preferred stock, payable January 1 to stock of record December 26. Capitol Traction Company; quarterly dividend of one-and-one-half per cent, payable January 1. Continental Passenger Railway; semi-annual dividend of $3, payable December 30. Germantown Passenger Railway; quarterly dividend of $1.31¼, payable January 5. Honolulu Rapid Transit and Land Company; quarterly dividend of one per cent on the common and three per cent on the preferred, both payable December 31. Manila Electric Railroad and Light Company; quarterly dividend of one per cent, payable December 31. Massachusetts Electric Companies; preferred stock dividend of $1, payable January 1. Philadelphia Company; quarterly dividend of one-and-one-half per cent, payable February 1 to holders of record January 2. Rochester Railway Company; quarterly dividend of one-and-one-fourth per cent, payable December 31. Stark Electric Railroad; quarterly dividend of three-fourths of one per cent, payable January 1. Toronto Railway Company; quarterly dividend of one-and-one-half per cent, payable January 2.

ELECTRICAL SECURITIES FOR THE WEEK ENDED DECEMBER 12.

New York:	*Closing.*
Allis-Chalmers common	15⅜
Allis-Chalmers preferred	48¾
Brooklyn Rapid Transit	58
American Telephone and Telegraph Company	127¾
General Electric	157½
Interborough-Metropolitan common	18¼
Interborough-Metropolitan preferred	43⅜
Kings County Electric	126
Mackay Companies (Postal Telegraph and Cable) common	73¾
Mackay Companies (Postal Telegraph and Cable) preferred	69
Manhattan Elevated	149⅞
Metropolitan Street Railway	33
New York and New Jersey Telephone	110
Western Union (ex-dividend)	66⅞
Westinghouse Manufacturing Company	86

At a special meeting of the Edison Electric Illuminating Company of Boston, held December 18, stockholders voted to increase the capital from 126,436 to 136,161 shares. This new issue of 9,725 shares will be offered to stockholders of record December 18 for subscription at $215 a share—the price determined by the Massachusetts Gas Commission—on the basis of one new share for each thirteen shares now held. Subscription books close January 15 and subscriptions are payable as follows: One hundred dollars on February 1 and $115 on May 3, 1909. Subscriptions for the new shares of the Edison Company of Boston will be received at the Old Colony Trust Company. Interest at the rate of four per cent per annum will be allowed on the first installment ($100 per share) from February 1 to May 1, 1909. Subscribers may prepay the second installment ($115 per share) on February 1, 1909, in which case interest will be allowed thereon at the rate of four per cent per annum from February 1 to May 1, 1909. Shares not subscribed for will be sold at auction.

For the last month gross earnings of the Brooklyn Rapid Transit have shown a decided improvement over the corresponding days last year. Since December 1 this increase has been running at the rate of $1,000 a day.

For the first three months of the current fiscal year, which began July 1, gross earnings showed a sharp falling off, compared with the same quarter of 1907, the decrease slightly exceeding six per cent. It was not until November 1 that earnings began to break even with last year, and only within three weeks that a noticeable gain has been shown.

It is probable that for the six months, to end the last of this month, the company will show a decrease in gross of about four per cent.

Like many other trolley systems, however, Brooklyn Rapid Transit has been remarkably successful in cutting down its operating expenses during the last six months. The economies effected have been strictly legitimate and have in nowise resulted in scaling down the standard of maintenance. As a result net earnings are on a practical parity with last year.

It is understood that the floating debt of $4,000,000 on June 30, the close of the fiscal year, has been cut down over $1,000,000, and there is a strong probability that it will be cut nearly $2,000,000 more by the close of the fiscal year. The company is in no need of financing and is able to take care of its current construction requirements out of net earnings.

Boston:	*Closing.*
Edison Electric Illuminating	250
Massachusetts Electric	57⅛
New England Telephone	126½
Western Telephone and Telegraph pref	79
Philadelphia:	*Closing.*
Electric Company of America	11
Electric Storage Battery common	44
Electric Storage Battery preferred	44
Philadelphia Electric	11
Philadelphia Rapid Transit	21¼
United Gas Improvement	91
Chicago:	*Closing.*
Chicago Telephone	127
Commonwealth Edison	106
Metropolitan Elevated preferred	52
National Carbon common	85½
National Carbon preferred	112

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

SABIN, WIS.—The Mill Creek Telephone Company has been incorporated.

HURON, S. D.—F. H. Kent and others have secured a telephone franchise at Huron.

BELLO, TEX.—The Bello Telephone Company has been incorporated by Charles Wild and others.

DISNEY, NEB.—The Spring Ranch Telephone Company has been incorporated with a capital of $5,000.

KALISPELL, MONT.—The farmers near Kalispell are making an effort to have a local telephone system. C.

ESSEX, IOWA—The Farmers' Telephone Company has been incorporated with a capital stock of $15,000.

NEOSHO, MO.—The Farmers' Union Telephone Company has been incorporated by J. B. Graves and others. P.

ADA, OKLA.—The Farmers' Independent Telephone Company has been granted a telephone franchise for Ada.

LADORA, IOWA—The Farmers' Mutual Telephone Company has been incorporated with a capital of $20,000.

CARNEGIE, OKLA.—The Carnegie Telephone Company has been incorporated with a capital stock of $10,000.

LEBANON, WIS.—The Lebanon Telephone Company has been incorporated with a capital stock of $10,000.

LADORA, IOWA—The Farmers' Mutual Telephone Company has been incorporated with a capital stock of $20,000.

IPSWICH, S. D.—The Union Township Telephone Company has been incorporated with a capital stock of $10,000.

NEW KENT, VA.—A company with a capital stock of $5,000 has been formed to build a telephone system in New Kent.

CLARINDA, IOWA—The Clarinda and Bethesda Telephone Company has been incorporated with a capital stock of $1,000.

MARSHALLTOWN, IOWA—The Farmers' and Merchants' Telephone Company has been incorporated with a capital stock of $250,000.

COOPERTON, OKLA.—The New State Telephone Company has been incorporated with a capital stock of $25,000 by W. C. Winnsworth and others. P.

ELECTRIC RAILWAYS.

(Special Correspondence.)

SEATTLE, WASH.—W. S. Boody and others have applied for a subway street-railway franchise in Seattle.

GUADALAJARA, MEXICO—The Compania de Tranvias, Luz y Fuerza of Guadalajara, has increased its capital stock from $3,000,000 to $8,500,000. Andres Bermejillo is president. D.

TORREON, MEXICO—The new electric power plant which the Lerdo & Torreon Electric Railway Company is erecting at a cost of $400,000 will soon be finished. The company will also make other extensive improvements. D.

ORIZABA, MEXICO—The Compania Empresa Electrica will, it is reported, expend $300,000 in the construction of a system of electric railways at Orizaba. The company was recently organized and is composed of local capitalists. D.

BUCK, ILL.—The Egyptian Steam and Electric Railway Company of Buck has been incorporated to construct and operate a railway from East St. Louis to Metropolis, Ill. The capital stock is $5,000 and John Edmonds is one of the incorporators.

TACOMA, WASH.—The Cle Elum-Roslyn Railway and Power Company of Cle Elum, incorporated by Frank S. Farquahar and W. E. Farquahar, with a capital stock of $100,000, will construct and operate an electric interurban railway between Roslyn and Cle Elum.

MEXICO CITY, MEXICO—The Mexico Tramways Company has been authorized by the Federal Government to convert its existing mule-car lines to electric traction and operate them as part of ts local electric-railway system. The improvements will be made immediately. D.

BAYONNE, N. J.—Civic organizations of Staten Island and Bayonne are considering a rapid transit scheme whereby it is proposed to construct a surface electric line from Perth Amboy to Port Richmond, then to tunnel the Kill von Kull to the Jersey Central Station in Bayonne, and eventually reach Manhattan by the Hudson River tunnel.

HERMOSILLO, MEXICO—It is reported that the branch line of the Sonora Railroad, which runs from La Union to Hermosillo, is to be sold to a local company and that it will be converted to electric traction. Negotiations have not yet progressed to a point when a definite announcement of the sale of the road can be made, but it is said that there is little doubt that the transaction will be consummated. The branch line runs up the canyon of the Sonora River and is said to be unprofitable as now operated. D.

LANCASTER, PA.—The property of the Philadelphia, Coatesville & Lancaster Electric Railway Company, which has defaulted payment on the interest of its first mortgage bonds for $600,000, recently due, will be sold on December 30. It is understood that this is a step in the acquirement of the franchise by the Conestoga Traction Company, which operates the trolley system of Lancaster County, and that as soon as it gets a title to it it will extend its Christiana line through to Parkersburg, to connect with the line to Philadelphia.

LITTLE ROCK, ARK.—A charter has been granted to the Helena, Parkin and Northern Railway Company, which proposes to build a line of railway, fifty miles in length, through St. Francis, Cross and Poinsett counties. The line begins at Whitmore, in St. Francis County, and extends to Marked Tree, in Poinsett County. The capital stock of the company is $350,000, of which amount $100,000 has been subscribed. It is reported that everything is in readiness to begin work at once. The incorporators are headed by T. E. Hare.

MEXICO CITY, MEXICO—The Arizona Mercantile Transportation and Smelter Company, which operates mines and smelters at Silver Reef, Ariz., has taken preliminary steps to obtain a concession from the Mexican government for building a railroad across a section of Mexican territory to reach St. George's Bay, a proposed deep-water harbor situated in the extreme upper end of the Gulf of California. The project is an ambitious one and contemplates the building of an electric railway 160 miles long, to run from Maricopa, Ariz., across the lower part of that territory and into Mexico to the prospective deep-water terminus. The company's plans also include the establishment of extensive port facilities at St. George's Bay, making it the outlet for the export traffic of a large section of the Southwest. D.

GUADALAJARA, MEXICO—The preliminary survey for the proposed electric railway which the Soledad Development Company is to build to the Mezquital del Oro mining district, in the state of Zacatecas, is nearly finished, and it is declared by the promoters of the enterprise that the construction of the line will soon begin. Application has been made to the government of the state of Jalisco for a concession for that part of the line that is to run through that state, and similar application will be made to the government of the state of Zacatecas for the remaining portion. The line will be about seventy-five miles long and will traverse a territory that is thickly populated. A hydroelectric plant will be installed on the Santiago River, and power for the line will be obtained from that source. The particular object of the proposed road is to afford a transportation outlet for the Mezquital del Oro mining district. D.

MEXICO CITY, MEXICO—It was given out by Dr. F. S. Pearson, president of the Mexico Tramways Company, on the occasion of his recent visit, that a general programme of improvements for the local system of electric street railway has been discussed with the government officials and arrangements completed to expend, within the next three years, about $5,000,000 gold. This sum is to be used principally in the construction of new lines in different parts of the city and in adding equipment for both passenger and freight service. D.

PERSONAL MENTION.

MR. A. B. DU PONT, former president of the Municipal Street Railway Company of Cleveland, O., has been retained by the company as consulting electrical engineer.

MR. A. G. PERRY has been appointed manager at North Vancouver, B. C., for the British Columbia Electric Street Railroad Company in place of W. B. Bunbury, who has resigned. R.

MR. WALTER E. HOLLOWAY, after twenty years' service with the Safety Insulated Wire and Cable Company, of New York city, will leave the position of general purchasing agent for the company, January 1, to enter into business for himself.

MR. W. R. BONHAM has been appointed sales manager for Cook County, Illinois, for the Electro-Dynamic Company, Bayonne, N. J., representing this company's full line of special and standard inter-pole motors. Mr. Bonham's headquarters are in the Monadnock Building, Chicago.

MR. HERBERT E. STONE has just become connected with the Dearborn Drug and Chemical Works as manager of sales in the eastern department, with headquarters in New York city. Mr. Stone was formerly president of the N. A. S. E., and recently manager of the Pittsburg office of the Chapman Valve Company.

MR. S. M. MANIFOLD, York, Pa., has removed to Morristown, N. J., accepting a position as general manager of the Morris County Traction Company, which connects the cities of Morristown, New Brunswick, Elizabeth and Orange. Mr. Manifold is a well-known and able railway man and was at one time general manager of the York Railways Company. O.

MR. W. D'A. RYAN, illuminating engineer for the General Electric Company, delivered a lecture on "Light and Illumination" on December 11 at the Memorial Hall, Minneapolis, Minn., under the auspices of the Minneapolis Electric Club. His address treated of illumination in general, describing and illustrating in particular the color values of the different illuminants and the effects of wall colorings.

MR. WILSON S. HOWELL, general manager of the Electrical Testing Laboratories of New York city, was a recent visitor to Chicago, in conference with the many interests with which this progressive enterprise is identified. So greatly has the work of the laboratories been extended, the value of scientific testing being conceded, that the possibility of further extension is being considered by those in charge of the work.

MR. FRANK J. DUFFY, manager of the Beaumont (Texas) Traction Company for several years, will leave Beaumont to make his headquarters in Natchez, Miss. The Natchez Street railway and lighting plant, the Jennings, La., lighting plant and the Beaumont Street railway are all under the same control, and Mr. Duffy will have general supervision over the Beaumont property in the future, but will resign active management. Mr. M. B. Rhoads of Key West, Fla., will succeed Mr. Duffy at Beaumont.

MR. KINGSLEY L. MARTIN, of Brooklyn, N. Y., has been appointed chief engineer of the Bridge Department of New York city, in place of Colin M. Ingersoll, resigned. Mr. Martin's salary will be $10,000 a year. At the request of Mayor McClellan and Bridge Commissioner Stevenson, Mr. Ingefsoll has agreed to remain with the Bridge Department in the capacity of consulting engineer. Mr. Martin was selected for the position of chief engineer because of the record he has made as engineer in charge of the Brooklyn and Williamsburg Bridges. He was born in Brooklyn in 1869, and is a son of C. C. Martin, formerly chief engineer and superintendent of the Brooklyn Bridge. He was educated in the Polytechnic Institute, of Brooklyn, and was graduated with the degree of M. E. from Stevens Institute of Technology. After serving for a short time on the engineering corps of the East River Bridge Company, Mr. Martin was appointed assistant engineer of the Brooklyn Bridge. He had charge of terminal reconstruction on the Brooklyn side, and of much of the railroad work, the local road at that time being operated by the city. He was made assistant engineer on the Williamsburg Bridge in 1896, and was connected with the Manhattan foundation and anchorage work. He was later appointed resident engineer in charge of construction work, including all the mill, shop and field work.

ELECTRIC LIGHTING.

(Special Correspondence.)

ALVIN, TEX.—E. B. Hill has secured a twenty-five-year electric-light franchise at Alvin.

MACON, GA.—The city is considering the erection of an electric-light plant in Vineville.

TENAHA, TEX.—Lemuel Hill has been granted a franchise for installing an electric-light plant.

VILLISCA, IOWA—F. P. Tyler has been granted an electric-light and power franchise at Villisca. P.

RYAN, OKLA.—A vote is to be taken on the issuance of bonds for an electric-light plant for Ryan.

DANVILLE, ARK.—The Danville Electric Company has been incorporated with a capital stock of $10,000.

TACOMA, WASH.—On December 26 Tacoma will vote on a proposition to issue bonds for a power plant. P.

MINCO, OKLA.—The city of Minco will vote on the issuance of bonds for the construction of an electric-light plant.

KEARNEY, NEB.—The Kearney Water and Electric Power Company has been incorporated with a capital stock of $310,000.

BERGEN, N. Y.—At a village election held in Bergen it was decided to issue bonds for $6,000 for an electric-lighting system.

EMPORIA, KAN.—The Emporia Electrical and Gas Lighting Company has been incorporated with a capital stock of $100,000. P.

KEARNEY, NEB.—The Kearney Water and Electric Power Company has been incorporated with a capital stock of $310,000. P.

NASHVILLE, ARK.—J. C. Stephenson has a contract for furnishing Nashville with electric light, and a plant will be installed at once. P.

ELBERTON, GA.—The city is considering improvements to its electric-light plant, including raising of dam and installation of larger dynamo.

EUFAULA, OKLA.—The pioneer Electric and Power Company has been incorporated with a capital of $9,500, by C. E. Foley and others.

WORDEN, ILL.—A special election was held in Worden to vote on the issuance of $12,000 in bonds to build a municipal electric-light plant.

MT. AYR, IOWA—The town of Mt. Ayr is the last county seat of Iowa to install electric lights. A $20,000 power plant is now nearing completion.

FARWELL, MICH.—The election on the proposition to bond the village for $3,000 for the erection of an electric-light plant carried by sixty-two to nineteen votes.

LOS ANGELES, CAL.—The Burrows Wave Power and Electric Company has been organized with a capital of $75,000, by E. E. Beazley, H. C. Scheurer and John H. Forsythe.

BRUCE, WIS.—The new $15,000 municipal hydroelectric plant built for the town of Bruce by the Central Construction Company of Oshkosh has been successfully started up.

LEESVILLE, S. C.—The Brodie Light and Power Company has been incorporated with $10,000 capital stock by Furman E. Brodie and Claudia E. Brodie, both of Leesville, and C. P. Quattlebaum, Conway, S. C.

NORCROSS, GA.—The city is having specifications prepared for an electric-light plant and will want bids on machinery. Five thousand dollars in bonds was recently reported voted. T. E. Johnson is mayor.

CARMI, ILL.—The plant of the Olney Electric Light and Power Company has burned, leaving the city in darkness for at least a month. The loss is $24,000, with $17,000 insurance. The cause of the fire is unknown.

MARINETTE, WIS.—The Iron Mountain Electric Light Company has taken action to purchase the Twin Falls waterpower plant on the Menominee River. It will be developed at a cost of $50,000 and the power will be transmitted to Iron Mountain to light that city.

MARENGO, ILL.—Fred A. Rispen, who held the lease and management of the city electric-light plant for a term of years, has made an assignment, declaring that its operation was a losing undertaking. Following his affidavit he was appointed to manage the plant for the city for a time.

LYNCHBURG, VA.—Virginia and Northern capitalists propose the organization of a company, probably capitalized at $1,000,000, to build a waterpower electric plant on Staunton River, twenty-five miles south of Lynchburg. The plan includes the construction of a concrete dam costing $350,000 and the transmission of electricity to Lynchburg and other cities.

CHARLOTTE, N. C.—B. H. Hardaway of Columbus, Ga., has been awarded the contract by the Southern Power Company, a $10,000,000 concern of Charlotte, to build a dam across Broad River at Ninety-nine Islands, S. C., for a 16,000-horsepower electrical plant. The contract price was $650,000. This dam will be the largest structure of its kind in the South.

KILBOURN, WIS.—The Southern Wisconsin Power Company has agreed to give the village 133 horsepower free of charge for twelve hours each day, for all time, to move the village plant to higher ground or fill where it now stands, to install pumps of sufficient capacity and connect the mains. This will, it is believed, end the fight between the company and the village.

JEFFERSON COUNTY, W. VA.—Fred H. Stith of Lexington, N. C., plans the organization of corporation to develop waterpower and build electric plant for transmitting by electricity a minimum of 1,000 horsepower from property on the Potomac River in Jefferson County. Surveys are now being made. About $300,000 is to be expended and the establishment of Portland cement plant is also proposed.

LEGAL NOTES.

Conducted by J. L. Rosenberger, LL.B.

ELECTRIC-LIGHT STATION A MANUFACTORY—Is or is not an electric-light station, with the usual equipment of boilers, engines, and dynamos, a manufactory, within the meaning of a restrictive covenant and "scheme" intended to exclude manufactories from a residence district? This was the important question in the case of Scrymser vs. Seabright Electric Light Company, 70 Atlantic Reporter, 977. In deciding it, the Court of Chancery of New Jersey says that, in its judgment, it is useless to go into speculative questions as to the nature of electricity or the nature of the product, if there be a product, of the electric plant in question. At different periods in the history of electrical discovery very different views have been entertained on this subject. At one time this plant might have been regarded as a manufactory of a "fluid." More recently it might be deemed to be turning out electrons or ions. This electric-light station, with the necessary incidents attending its operation, is, in the court's judgment, as clearly a manufactory, within the meaning of this protective covenant, as it is a manufactory within the meaning of the mechanic's lien law. It may be conceded that when this particular covenant was framed and building "scheme" was promulgated, about thirty-five years ago, the "manufacture" of electricity in electric-light stations was unknown. But in view of the annoyance and discomforts which it was the intention of the scheme to exclude from the large residential district in question, no distinction can be drawn between manufacturing businesses which were in existence when the scheme was promulgated, and manufacturing businesses which might thereafter come into existence.

DEMAND OF SPECIAL PRIVILEGES NOT FAVORED—While a telephone line was being constructed by a mutual company it became apparent that one wire would be inadequate for the service, and another wire was placed along the same route to the home of one of the subscribers for stock in the company. Both wires were run to his telephone, where a switch belonging to him was installed by which he was enabled to use either wire. The then president of the company testified that he agreed to put in the switch with the understanding that if the board of directors disapproved of it the party should take it out. The board of directors disapproved of it and ordered the switch disconnected. But the party reconnected it and threatened to do so as often as disconnection should be made. In a suit to enjoin the party from thus interfering with the line, the Supreme Court of Nebraska affirms a judgment in the company's favor. The Supreme Court commissioners, who prepared the opinion in the case, say, Red Line Mutual Telephone Company vs. Pharris, 117 Northwestern Reporter, 995, that they cannot see any particular reason why special privilege, if it might be called such, should be given to the defendant. The other patrons of the company paid the same amount as he did and were connected directly with but one line. At most, the contract was that adequate means of communication with the patrons of the company should be given to the defendant. The contract would not permit him perpetually to maintain his switch. Conceding that the contract contemplated but one line, it was not violated by the construction of two wires along the line, even though for convenience the wires were given different names and were connected at a central office when desired. The demoralizing effect of the defendant's maintenance of the switch was not a matter of conjecture, but was apparent from the evidence in the case, as one witness testified that it tended to make the line inefficient, hard feelings, trouble and discord on the line. The proper and businesslike conduct of the affairs of the company seemed to demand that this switch be removed, and with the company's purpose to remove it the courts would not interfere, but, necessity demanding it, would render assistance.

PROPOSALS.

POST OFFICE AT POUGHKEEPSIE, N. Y.—An electric system of a rather elaborate nature has been planned for the United States Post Office at Poughkeepsie, N. Y. Postmaster Sherrill has received the complete specifications from the office of the Supervising Architect at Washington, and is inviting bids for the installation.

POSTOFFICES AT MURFREESBORO, TENN., AND GAINESVILLE, FLA.—The office of the Supervising Architect, Washington, D. C., will receive sealed proposals until January 9 for the construction (complete) of the United States postoffices at Murfreesboro, Tenn., and Gainesville, Fla., in accordance with specifications which may be had at the office of the respective postmasters and at the office of the Supervising Architect.

POST OFFICE AT ANDERSON, S. C.—The office of the Supervising Architect, Washington, D. C., will receive sealed proposals until January 23, for the construction complete (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the United States Post Office and Court House at Anderson, S. C., in accordance with specifications, which may be obtained from the custodian of site at Anderson or at the office of the Supervising Architect.

DATES AHEAD.

American Roentgen-Ray Society. Annual meeting, New York city, December 28-30.

American Association for the Advancement of Science. Annual meeting, Baltimore, Md., December 28-January 2.

Western Society of Engineers. Next meeting, Chicago, Ill., January 5, 1909.

Chicago Electrical Show. Coliseum, Chicago, Ill., January 16-30, 1909.

Northwestern Electrical Association. Annual meeting, Milwaukee, Wis., January, 1909.

American Association of Electric Motor Manufacturers. Next meeting, January, 1909.

INDUSTRIAL ITEMS.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Conn., dresses *Trumbull Cheer* for December in Christmas colors. This issue has some shop notes which will interest.

THE OHIO BRASS COMPANY, Mansfield, Ohio, in a supplement to its general catalogue No. 7, shows new improvements in overhead line material, mine hangers, car equipment, specialties, etc.

THE GREGORY ELECTRIC COMPANY, Chicago, Ill., is distributing a comprehensive bargain sheet of apparatus carried in stock at its works. The list includes everything from miscellaneous supplies to steam engines and alternators.

THE NEW YORK INSULATED WIRE COMPANY, New York, N. Y., has placed on the desks of its friends calendar blotters with a few lines describing the manufacture and advantages of its rubber products for electrical insulation.

F. B. BADT & COMPANY, Monadnock Block, Chicago, electrical engineers and experts, who are the western agents for Weston instruments and Ward Leonard rheostats, have also been appointed western sales agents for "Polar" flaming-arc lamps.

THE ELECTRIC CONTROLLER AND MANUFACTURING COMPANY, Cleveland, Ohio, describes motor-control matters on those pages of its monthly, *Common Sense*, for December, which are not devoted to the epigrammatical writings of David Gibson.

THE NATIONAL BRAKE AND ELECTRIC COMPANY, Milwaukee, Wis., has a handsome illustrated bulletin, No. 386, explaining the advantages and economies of compressed air for industrial service, and describing compressors and controlling apparatus for motor-driven stationary and portable installations.

HARVEY HUBBELL, INCORPORATED, Bridgeport, Conn., has brought out a new ceiling socket equipped with the pull-switch feature, listed as Hubbell ceiling socket No. 35,032. The fixture is designed primarily for the tungsten lamp, and will sustain successfully the weight of the heaviest lamp and shade.

THE BUFFALO FORGE COMPANY, Buffalo, N. Y., describes the Buffalo fan system of heating, ventilating, humidifying and drying, in a handsome book it issues as Catalogue 197. A large part of the book is devoted to some very useful data on the heating and ventilating of public, industrial and other large buildings.

THE AMERICAN CONDUIT MANUFACTURING COMPANY, Pittsburg, Pa., announces that it has completed a large addition to its factory, which is equipped with up-to-date machinery, and is making thorough preparations to manufacture an improved flexible, non-metallic conduit. Patents are being taken out to cover these improvements.

THE MOHAWK ELECTRIC COMPANY, Albany, N. Y., manufacturers of Rollinson electrical specialties, issues a catalogue describing its alternating and direct-current bell ringers, designed to take the place of batteries in providing a low-voltage current supply for the operation of signal apparatus, deriving power from commercial current mains.

THE WORCESTER ELECTRIC MANUFACTURING COMPANY, Worcester, Mass., in its catalogue No. 8 describes its line of knife switches, switchboards, panel boards and fuse blocks for light, power and railway service on both direct and alternating-current circuits. The lists are complete with illustrations, dimensions and prices.

THE NORTHERN ELECTRICAL MANUFACTURING COMPANY, Madison, Wis., devotes its leaflet No. 148 to Northern motors for hoisting service. These motors are compact, simple, rugged and economical. The company's standard spherical motor is described in Bulletin No. 50, and Northern box-type motors are illustrated in Bulletin No. 32.

THE AMERICAN STEAM GAUGE AND VALVE MANUFACTURING COMPANY, 208-220 Camden Street, Boston, Mass., has issued its 1908 illustrated catalogue of gauges, valves, indicators and kindred appliances for governing, indicating, measuring, recording and controlling steam, water, air, gas, oil, ammonia and all other pressures.

THE SPRAGUE ELECTRIC COMPANY, 527-531 West Thirty-fourth Street, New York city, is sending out literature relating to the Sprague electric shovel. The manufacturer declares that this shovel can be used on mono-rails, bridge cranes or gantrys, on stiff-leg derricks, unloading towers, etc. By its use the second man required with a steam rig is entirely dispensed with.

THE J. L. SCHUREMAN COMPANY, Chicago, has prepared a convenient filing form for its bulletin pages, which allows the sheets to be added from time to time following the introduction of new controlling devices. On the pages already available are listed Schureman self-starters, drum-type reversing switches, elevator controllers, pump starters and motor controllers.

THE PACIFIC ELECTRIC HEATING COMPANY, Ontario, Cal., in the November issue of its little monthly, *Hot Points*, announces that the branch office formerly maintained by the company in Chicago has developed into a complete factory, which is located at 63-65 West Washington Street, and invites its customers and friends to call and inspect the plant at their convenience.

THE BUCKEYE ELECTRIC COMPANY, Cleveland, Ohio, is sending to its friends, the central-station operators, some "hard facts" and some interesting data on the saving effected by the use of tungsten lamps on lighting circuits. The moral of the striking folder is to the effect that economy at the illuminant means proportionately greater capacity of a given generating outfit.

THE PETTINGELL-ANDREWS COMPANY, Boston, Mass., has published an interesting article devoted to "The Theft of Current—How to Prevent It, and How to Simplify the Testing of Meters." This article is reproduced in a handsome booklet, and should be of great interest to contractors and central-station operators. Copies will be furnished to those interested upon request.

THE MINNEAPOLIS ELECTRIC EQUIPMENT COMPANY, Minneapolis, Minn., in its "Red Book of Bargains—Everything Electrical," lists a large variety of electrical apparatus actually in stock at the works and ready for immediate shipment. Included in the catalogue are all kinds of motors, generators, transformers, switchboards, electric lighting fixtures and supplies, and measuring instruments.

THE WESTERN ELECTRIC COMPANY, New York city, has issued a price list of "Galvaduct" conduit, couplings and elbows. This product, used in interior conduit work, has an enameled interior which presents a smooth raceway for electrical conductors, and an electro-chemically galvanized exterior which cannot be defaced. "Galvaduct" can be imbedded in concrete without the fear of any injurious effects.

THE GOLD CAR HEATING AND LIGHTING COMPANY, New York city, announces that the interference relating to electric heaters having junction boxes, between an application of James F. McElroy, and the patent granted to Edward E. Gold, No. 850,924, dated April 23, 1907, has been decided by the Patent Office in favor of Edward E. Gold, by reason of an abandonment by McElroy of his claim of priority.

THE FRANKLIN ELECTRIC MANUFACTURING COMPANY, Hartford, Conn., describes "Femco" tungsten and carbon-incandescent lamps and "Femco" reflectors, in bulletin No. 8. To quote the bulletin: "From the Goddess of Liberty guarding the portals of the new world to the greatest floating dry-dock in the world—the Dewey, at Manila—Uncle Sam is using 'Femcos.' There must be a reason. There is, and it's this: The 'Femco' offers a guaranteed uniform quality, prompt delivery and unfailing courtesy."

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., through its Chicago manager, R. M. Van Vleet, advises that owing to the increase in business in both controller and specialty departments, it has been found necessary to secure larger local offices and that two additions have been made to Mr. Van Vleet's force: Horace L. Dawson as an engineering aid, and F. G. Horle as a member of the sales force.

THE K. McLENNAN COMPANY, Chicago, the well-known manufacturers of Gale's commutator compound, report a constantly increasing demand for their products. As is well known this compound is extensively used by dynamo and motor users, not only in the United States, but in almost every portion of the civilized globe. The company will submit samples and full particulars to anyone who may not be familiar with this product.

QUEEN & COMPANY, INC., Philadelphia, Pa., issue a three-leaf folder descriptive of their portable voltmeters and ammeters, the list being complete with code, range of scale, sensibility and price. The instruments listed are of the permanent magnet type, moving coil system, for direct-current only. They are the result of many years' experience in making high-grade scientific and testing instruments. The accuracy of calibration is one-fifth of one per cent.

THE ELECTRIC SUCTION SWEEPER COMPANY, New Berlin, O., is distributing some literature describing and illustrating its electrical suction sweeper. This apparatus is a combined sweeper and vacuum cleaner and is handled as easily as an ordinary carpet-sweeper. Attachments are provided which remove dust or dirt from under stationary or heavy articles, and also from elevated objects, such as pictures, moldings, wall coverings and upholstered furniture.

THE ELECTRIC GOODS MANUFACTURING COMPANY, Boston, Mass., has issued a telephone section of its nineteenth edition catalogue, in which it describes and illustrates the extensive and practical line of telephone apparatus of its manufacture. The convenient styles of equipment admit a wide range of choice and meet many special needs. This catalogue is especially arranged to help the architect and contractor in the work of specifying and ordering, related subjects being near at hand.

THE HORNBERGER TRANSFORMER COMPANY, Lafayette, Ind., has prepared a bulletin and price list of its standard lighting transformers, which are made up to sizes with a capacity of 200 kilowatts. Silicon-alloy steel is exclusively used in the manufacture of the modified type of these apparatus. As this improved steel was used in these transformers almost two years ago, the manufacturers feel that their pioneer experience with the material has been of great service in securing refinement of design.

THE UNION ELECTRIC LIGHT AND POWER COMPANY, St. Louis, Mo., has prepared a really handsome bulletin to be sent to its local customers, describing and illustrating in detail the varied line of electrical heating devices that are now on the market. Specifications and price are given in each case. The company maintains a continuous electrical exhibition of these devices at its show rooms, Tenth and St. Charles Streets, and also offers customers a free trial of any piece of apparatus in their homes.

GEORGE W. JACKSON, INC., Chicago, has brought out a souvenir booklet of its disposal station department that is of unusual typographical excellence and technical and popular interest. The methods of carrying off city waste, excavation spoil, refuse and snow from the congested downtown district of Chicago by means of the freight tunnel system and river scows are described and illustrated and will prove an absorbing chapter for one who is interested in the great and peculiar problems undertaken by this corporation.

THE FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., has compiled a practical guide for transformer testing which is simply written and diagrammed so as to be of service to the practical central-station operator. The guide contains accurate directions for making the usual insulation, copper-loss, core-loss, impedance, ratio, polarity, heat and regulation tests, as well as an amount of useful data in connection with these determinations. Bulletin No. 1109 illustrates the line of engine-driven multiphase alternators manufactured by the Fort Wayne Electric Works.

THE AMERICAN BOILER ECONOMY COMPANY, North American Building, Philadelphia, has prepared a handsomely executed treatise describing the Copes boiler-feed regulator. In turn, the several advantages to be gained by automatic regulation are taken up, such as protection to the boiler, protection to the engine or turbine, saving of cylinder oil, lessened friction and wear in the engine, higher efficiency of super-heaters, higher efficiency of engines and turbines, and greater economy from exhaust steam feed-water heaters and fuel economizers. The engineering considerations of these points are brought out fully, bull's-eye charts from recording thermometers being shown, for instance, to demonstrate the fuel-saving realized by holding the feed always equal to the evaporation. In addition there are numerous illustrations showing installations of Copes regulators, also the manner of operation and construction of the regulator and of the Copes pump governor employed to insure a constant excess of pressure in the feed line. This appliance is especially valuable in large plants where the water level must be maintained in a great number of boilers and should be of interest to consulting, designing and managing engineers.

THE COMMONWEALTH EDISON COMPANY, Chicago, maintains its repair shops at 76 Market Street, which are said to be one of the largest and best-equipped repair shops in the world. The company is in a position to handle any kind of repair work, whether mechanical or electrical. The completeness of the equipment, it is stated, guarantees lowest costs, while the facilities for turning out work quickly are exceptonal. Temporary motors will be installed, when required, so that the service will not be interrupted. Repair work of any kind will be called for and delivered without extra charge.

J. B. TAYLOR & COMPANY, New York, have been incorporated under the laws of the state of Delaware, with a capital stock of $500,000, for the purpose of entering the field of engineering, construction, reorganization and the financing of street railway, steam railroads, water works, gas, electric light and organization propositions. The company has offices in the Hudson Terminal Building. Taylor & Company have already secured a contract to build the Sanoody Valley Railroad, connecting with the Mobile & Ohio Railroad at Sucarnochee, Miss., and are organizing a capable engineering and construction force.

THE STANDARD ROLLER BEARING COMPANY, Philadelphia, Pa., is distributing an illuminative list of the extensive floor spaces occupied by its various departments. The company believes that its broad experience in supplying over a million bearings of various types, for all classes of work, has resulted in the accumulation of much data of inestimable value, from which it is enabled to design bearings for all loads and speeds. Manufacturing over fifty types of ball and roller bearings, all having their proper uses, the company is naturally well equipped to recommend the proper bearing for any specific condition or purpose.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., in the December number of *Graphite* illustrates the use of graphite points on lighting rods protecting tall chimneys. The tip is made with a pointed graphite pencil, one inch in diameter and five inches in length, set into a cap to fit standard pipe. A hole drilled part way up the axis of the graphite rod receives the copper conductor cable, which is held in place by a set-screw. The Alphons Custodis Chimney Construction Company, which has been using these tips, reports that not a single chimney thus protected has been damaged by lightning, although there are numerous records of similar but unprotected structures sustaining severe injury.

THE CENTRAL ELECTRIC COMPANY, Chicago, is distributing a circular on "Combat" ignition batteries for automobile and gas-engine service. The circular contains a full description of the battery construction, and also gives directions for charging from the regular lighting circuits. It is asserted that corrosion at the binding posts is made impossible by the arrangement of the terminals. The company is also distributing several new fliers on condulet and box receptacles to fit the various makes of boxes now on the market. In the new design it is declared that the amount of breakage is minimized and furthermore that the contacts are of capacity to withstand extremely heavy overloads.

THE AMERICAN BATTERY COMPANY, Chicago, Ill., has published a sixteen-page booklet describing American electrolytic rectifiers. The construction, use and maintenance of the rectifiers are subjects treated at length in several pages. American rectifiers are made in a variety of styles and sizes designed to meet the demand for a low-price converter for making use of an alternating-current supply for the charging of storage batteries of from one to fifty cells of any capacity up to 300 ampere-hours. They may be profitably used in the charging of storage batteries of the ignition type for electric vehicles, storage batteries for dentists' and physicians' use, for telephone, telegraph and signal work, and for many other applications.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., in bulletin No. 4630 lists and describes its direct-current portable type DP instruments, which have been designed for laboratory and general testing purposes. These instruments are constructed to be well protected from mechanical injury and from the effect of stray fields. The indications of the pointer are rendered dead-beat. This line of instruments comprises ammeters, voltmeters, milammeters and millivoltmeters. General Electric bulletin No. 4629 is devoted to automobile accessories manufactured by the company. The apparatus illustrated consists of charging panels of various types, automobile instruments and incandescent lamps, motor-generator sets, automobile motors and controllers, battery-charging rheostats, low-tension magnetos, air-compressor outfits, etc.

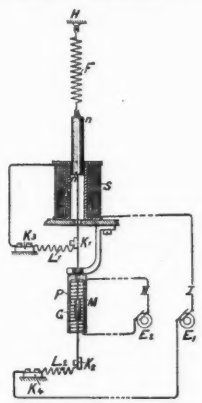
RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) December 15, 1908.

906,509. ELECTRIC WATER VALVE. George P. Carroll, Bridgeport, Conn. Filed March 25, 1907. The port is automatically held open by an electromagnet when power is on the line.

906,513. TELEPHONE SYSTEM. William W. Dean, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. Filed November 11, 1903. Relates to a special arrangement of supervisory and cut-off relays.

906,523. SELECTIVE MECHANICAL OPERATOR. Edwin R. Gill, Yonkers, N. Y. Filed March 12, 1906. A machine element intended to be brought to a predetermined position has a main impelling device adapted to move step by step by means of a magnet and its armature.



906,550.—NERNST LAMP.

906,550. ELECTRICAL INCANDESCENT LAMP. Walther Nernst, Göttingen, Germany, assignor to Nernst Lamp Company, Pittsburg, Pa. Filed October 20, 1897. The heating coil for a Nernst lamp is described.

906,556. VULCANIZER. Frank C. Perkins, Buffalo, N. Y., assignor of one-half to Ferdinand E. Finsterbach, Buffalo, N. Y. Filed October 9, 1907. A heating chamber has a removable wall with inner and outer sockets secured to it, the inner socket receiving an incandescent lamp and the outer socket a plug for the feed wires.

906,576. ELECTRIC CONTROLLER. Clarence L. Taylor, Alliance, Ohio, assignor to The Morgan Engineering Company, Alliance, Ohio. Filed February 21, 1908. In combination with a casing containing oil is a contact drum, a set of contact fingers and operating mechanism, all supported by and removable with the hinged cover.

906,582. AUTOMATIC TRAIN STOPPER. Charles D. Tisdale, Randolph, Mass.; Frank L. Tisdale, administrator of said Charles D. Tisdale, deceased. Filed May 16, 1907. A locomotive has a brush fixed to its pilot and adapted to engage a fixed track contact, a battery being grounded on the wheels and an electric motor adapted to operate the air-brake valve.

906,599. MAGNET SHIELD. Charles E. F. Ahlm, Cleveland, Ohio, assignor to Electric Controller and Supply Company. Filed January 13, 1908. A lifting magnet with an inner and an outer pole has a magnetizing winding between the poles and an annular shield for retaining the winding.

906,602. PRIVATE-BRANCH-EXCHANGE TELEPHONE SYSTEM. Frank Arens, Cincinnati, Ohio. Filed December 28, 1907. In combination with the cord mains is a shunt circuit controlled by the relays.

906,615. REPAIRING AND TESTING MEANS FOR CONTACTLESS THERMAL PROTECTORS. Frank B. Cook, Chicago, Ill. Filed July 28, 1905. A repairing tool comprises a handle, a metallic contact strip and a lever pivoted on an insulating support and provided with a thumb-piece adapted to be depressed.

906,618. PERFORATOR FOR PREPARING TELEGRAPHIC TRANSMITTING TAPES. Patrick B. Delany, South Orange, N. J., assignor to The Telepost Company of Maine, Augusta, Me. Filed April 16, 1902. An electromagnetic perforator consists of a key, a pole-changer magnet controlled thereby, a differentially-wound polarized relay and punch magnets controlled by the relay and pole changer.

906,636. RAILWAY SAFETY SYSTEM. Janko Kovacevic, Youngstown, Ohio. Filed October 14, 1907. The railway is equipped with three parallel contact strips controlling a signal on the locomotive.

906,649. SHOAL-WATER ALARM. Patrick McCarthy, Cleveland, Ohio. Filed June 1, 1908. The ship carries a drag cable with an inclined blade at its free end and an electric alarm to indicate when the device is in contact with the bottom.

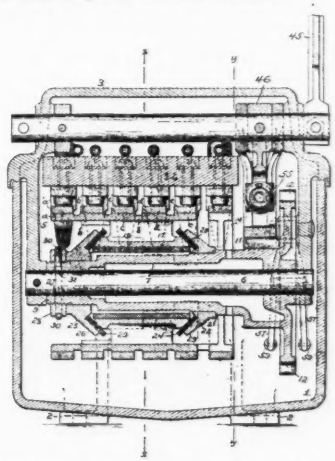
906,659. COMBINATION PUMP AND COMPRESSOR SYSTEM. Walter J. Richards, Milwaukee, Wis., assignor to The National Brake and Electric Company, Milwaukee, Wis. Filed July 9, 1908. A motor drives either one of two pumps through a pair of magnetic clutches.

906,669. ELECTROLYTIC APPARATUS FOR USE IN THE MANUFACTURE OF BLEACHING LIQUORS. Alfred Vogelsang, Dresden, Germany. Filed March 5, 1907. A number of compartments are situated one above another in a stair-like manner, an electrode between two successive compartments extending upwardly and forming a wall for the compartment next above it.

906,682. ELECTRIC FURNACE. Kristian Birkeland, Christiania, Norway. Filed January 5, 1907. A long electric furnace has distanced electrodes to produce a long arc and electromagnetic means to distort the arc into a helix.

906,726. APPARATUS FOR DETINNING TIN SCRAP. Meredith Leitch, Elizabeth, N. J., assignor to Metal Process Company. Filed February 28, 1907. In combination with a stationary cathode and an anode is a tank for the electrolyte and a hydraulic plunger for lowering and raising it.

906,729. IGNITION TIMER FOR INTERNAL-COMBUSTION ENGINES. Francis C. Mason and Guy L. Sintz, Grand Rapids, Mich., assignors to Norman W. Chamberlin, Grand Rapids, Mich. Filed October 26, 1906. A rotative shaft carries a tubular head and a yoke with a contact.



906,576.—ELECTRIC CONTROLLER.

906,738. SNAP-SWITCH. Johann G. Peterson, Hartford, Conn., assignor to The Arrow Electric Company, Hartford, Conn. Filed April 10, 1908. The actuating mechanism has a pole-carrying plate with integral arms upturned from diametrically opposite edges and perforated pole plates slipped upon the arms.

906,739. ELECTRIC-SWITCH RECEPTACLE. Johann G. Peterson, Hartford, Conn., assignor to The Arrow Electric Company, Hartford, Conn. Filed September 16, 1908. Describes the construction and method of mounting the cover for the receptacle.

906,740. PUSH-BUTTON ELECTRIC SWITCH. Johann G. Peterson, Hartford, Conn. Assignor to the Arrow Electric Company, Hartford, Conn. Filed September 16, 1908. A two-button oscillating switch.

906,749. APPARATUS FOR OPERATING WINDOWS. Wilson B. Strong, Easthampton, Mass. Filed December 5, 1907. Comprises two electric motors with a winding drum secured upon each shaft, a cord wound upon each drum and adapted for connection with each sash.

906,762. PUSH-BUTTON. Henry Wilhelm, New York, N. Y. Filed November 30, 1907. The button passes through a cap that fits over a cup.

906,787. INSULATOR PIN. Charles G. Ette, St. Louis, Mo., assignor to Ette Investment Company, St. Louis, Mo. Filed May 4, 1908. A metallic pin is provided at its lower end with an integral tongue that is adapted to be bent into engagement with the cross-arm.

906,799 and 906,800. LOCK AND BLOCK-SIGNAL SYSTEM. Robert J. Hewett, Westfield, N. J., assignor to The Hall Signal Company. Filed January 10, 1908. A circuit connecting signaling stations has circuit-breakers interposed in it and controlled by the traffic and means acting automatically to lock a manual controlling member and transmit a relese when the circuit has been closed.

906,861. ELECTRICAL BLOCK-SIGNALING SYSTEM FOR RAILWAYS. George H. Brown, Belfast, Ireland. Filed September 20, 1907. There are in combination conductors on the track, audible and visible electrical signaling devices on the engine and similar devices in each signal cabin.

906,926 and 906,927. ELECTRICAL APPARATUS FOR TIMING CLOCKS AND WATCHES. Wilson E. Porter, New Haven, Conn., assignor to New Haven Clock Company, New Haven, Conn. Filed April 27, 1908. A timing mechanism is located in an electric circuit and provided with a rated pointer driven in unison with the master clock.

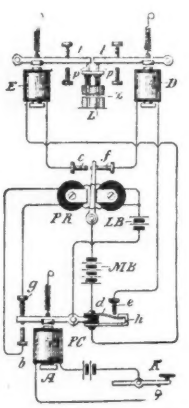
906,928. METHOD OF MAKING DYNAMO BRUSHES. Georg Preuss, Charlottenburg, Germany. Filed July 31, 1906. Pure graphite is moistened with nitric acid and afterward heated. the graphite forms resulting being provided electrically with a metal coating and then formed and pressed into brushes.

906,939. ELECTRICALLY-OPERATED GUN CONTROL. James B. Ryan, Hoboken, N. J., assignor to Stephen A. Farrell, Brooklyn, N. Y. Filed February 3, 1908. There are means controllable by the undesirable motions of a vessel for reversing the motor and another mechanism similarly controlled for varying the energy supplied to the motor.

906,984. RETRIEVING MECHANISM FOR TROLLEY POLES. Martin L. Addington, Indianapolis, Ind., assignor of one-third to John E. Hafner, Indianapolis, Ind. Filed March 3, 1908. A rotary drum has separate cords attached thereto to simultaneously wind and unwind respectively and an automatically actuated motor connected with one of the cords.

906,990. ELECTRICAL HEATING APPARATUS. Clifford D. Babcock, New York, N. Y., assignor to United Wireless Telegraph Company, New York, N. Y. Filed July 24, 1907. Comprises a number of bare uninsulated coils arranged one above the other in a vessel.

906,991. OSCILLATION DETECTOR. Clifford D. Babcock, New York, N. Y., assignor to United Wireless Telegraph Company, New York, N. Y. Filed October 2, 1907. Consists of a thermo-electric couple and a local circuit in combination with means for converting the energy of the oscillations into heat and thereby elevating the temperature of the couple.



906,618.—ELECTROMAGNETIC TELEGRAPHIC-TAPE PERFORATOR.

906,994. TROLLEY. Frederick C. Bauer, Sr., and Frederick C. Bauer, Jr., Camden, N. J. Filed May 1, 1908. The wheel has a central groove with deep spiral grooves on either side.

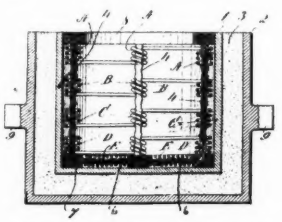
907,002. SPARK PLUG. Henry L. Brownback, Norristown, Pa. Filed January 15, 1908. A shell is formed with a fixed arm projecting within and a number of sparking points projecting in opposite directions from the terminus of the arms.

907,061. METHOD OF DETINNING TIN SCRAP. Meredith Leitch, Springfield, Mass., assignor to Metal Process Company, New York, N. Y. Original application filed February 28, 1907. Divided and this application filed September 19, 1908. The method consists in drawing the caustic soda electrolyte out of the bath from beneath the surface and returning it to the bath at a point below the surface.

907,062. TELEPHONE DROP. Tiodolf Lidberg, Chicago, Ill., assignor to Swedish-American Telephone Company, Chicago, Ill. Filed November 26, 1906. An armature and latching mechanism is secured to the stationary part and a removable electromagnet is arranged for insertion or withdrawal relative to the support.

907,083. RAIL BOND. Edwin H. McHenry, New Haven, Conn., assignor of one-fourth to Charles H. Morrison, New Haven, Conn. Filed March 16, 1908. Consists of a spring steel core provided with a coating of copper.

907,088. ELECTRIC TIME-SWITCH. Ole P. Noisom and Carl J. Lindewald, South Bend, Ind.; said Lindewald assignor of one-half to said Noisom. Filed January 27, 1908. Comprises a switching element movable in a circular path with a step-by-step movement.



906,990.—ELECTRIC HEATER.

907,098. PUSH-BUTTON SWITCH. George B. Thomas, Bridgeport, Conn., assignor to The Perkins Electric Switch Manufacturing Company, Bridgeport, Conn. Filed June 5, 1908. A switch has two push-buttons and an oscillating operating lever with connecting links pendent from ends thereof.

907,106. THREE-POSITION MOTOR SIGNAL. Clarence W. Coleman, Westfield, N. J., assignor to The Hall Signal Company. Filed September 27, 1907. Electrically-operated locking and releasing means consist of a step pivotally mounted on the signal actuating member.

907,108. INSULATOR FOR CIRCUIT-BREAKERS. Leonard L. Elden, Dorchester, Mass., assignor to Sears B. Condit, Jr., Boston, Mass. Original application filed June 20, 1901. Divided and this application filed December 2, 1903. An oil switch has an oil well removably suspended in position to submerge the electrodes in all their operative movements.

PATENTS THAT HAVE EXPIRED.

Following is a list of electrical patents (issued by the United States Patent Office) that expired December 22, 1908:

465,444. ELECTRIC SWITCH. H. Barton, London, England.

465,469. ELECTRIC-RAILWAY TROLLEY. C. S. Foster, Whitesborough, N. Y.

465,511. ELECTRIC SNAP SWITCH. Wm. S. Andrews, New York, N. Y.

465,512. RHEOSTAT. W. S. Andrews and A. K. Warren, New York, N. Y.

465,514. ELECTRIC ARC LAMP. H. P. Ball, Brooklyn, N. Y.

465,525. ELECTROLYTIC APPARATUS FOR TREATING METALS. E. S. Hayden, Waterbury, Conn.

465,592. GEARING FOR ELECTRIC MOTOR CARS. O. F. Evans, Columbus, Ohio.

465,594. SYSTEM OF ELECTRICAL DISTRIBUTION. F. O. La Roche, Philadelphia, Pa.

465,602. ELECTRIC CIRCUIT-CLOSER FOR BURGLAR ALARMS. Wm. C. Thompson, Minneapolis, Minn.

465,613. ELECTRIC RAILWAY. Wm. H. Applegate, Atlantic, Iowa.

465,618. ELECTRIC SWITCH. G. E. Painter, Baltimore, Md.

465,648. COMBINED SIGNAL AND TELEPHONE SYSTEM. T. W. O'Brien, Wilkes-Barre, Pa.

465,685. ELECTRIC ARC LAMP. H. C. Waldecker, Austin, Minn.

465,805. MEANS FOR TURNING ON AND OFF ELECTRIC CURRENTS. T. C. Smith and B. D. Acker, Philadelphia, Pa.

465,806. ELECTRIC-RAILWAY TROLLEY. F. J. Sprague and P. F. O'Shaughnessy, New York, N. Y.

465,808. DYNAMO-ELECTRIC MACHINE. R. Thury, Geneva, Switzerland.

465,809. ELECTRICAL TESTING INSTRUMENT. R. Varley, Jr., Englewood, N. J.

ELECTRICAL REVIEW

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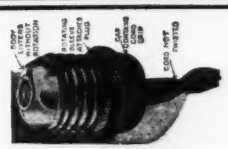

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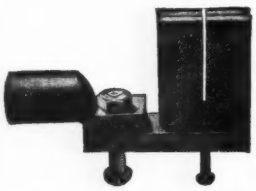

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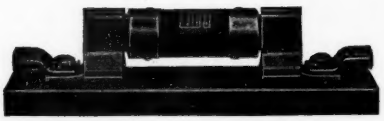

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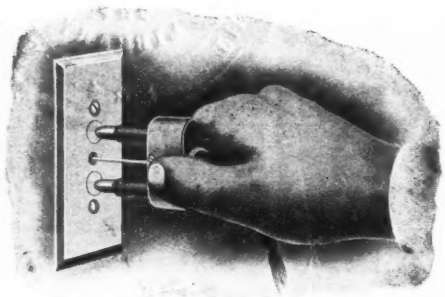

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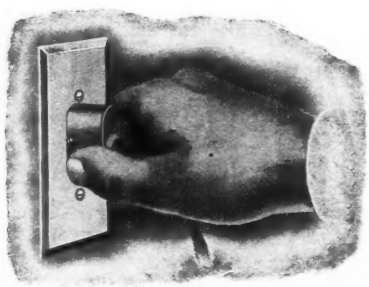

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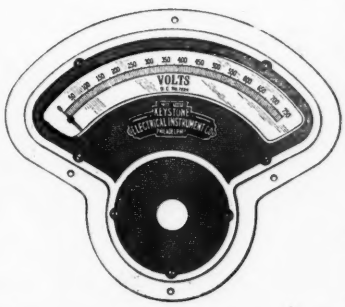

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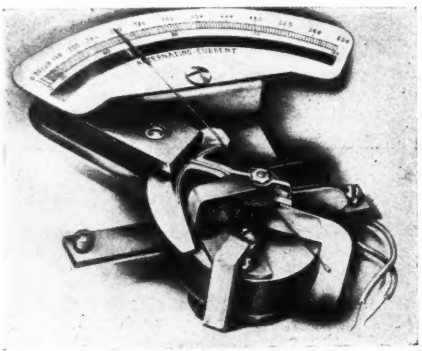

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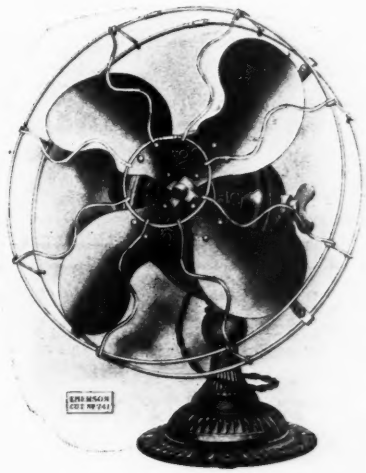

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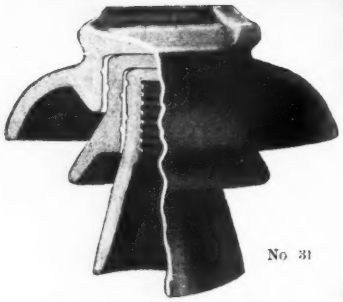

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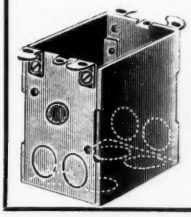

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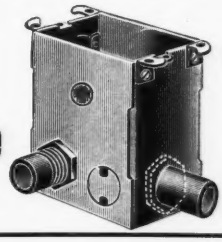

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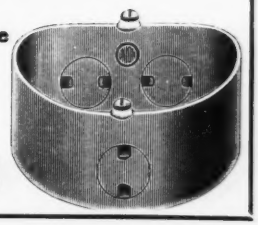

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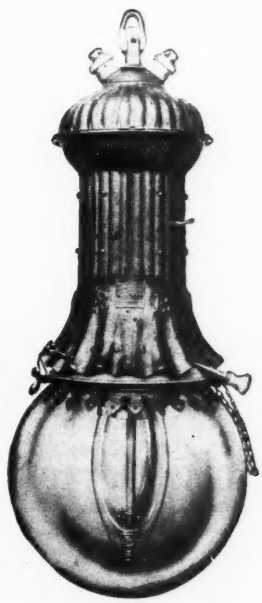

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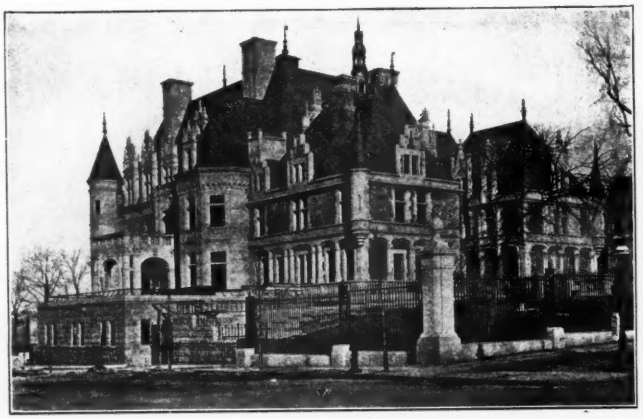

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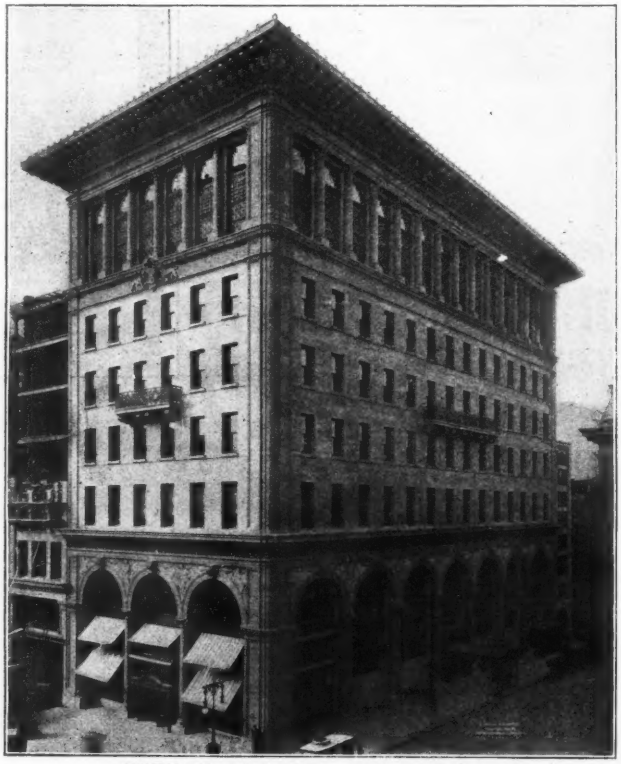

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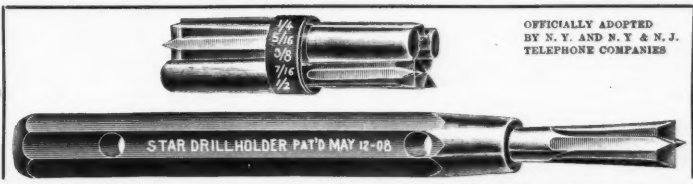

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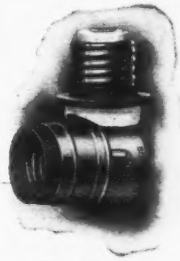

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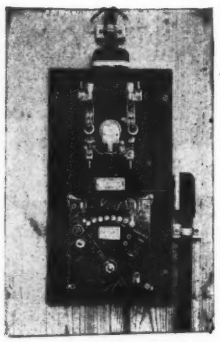

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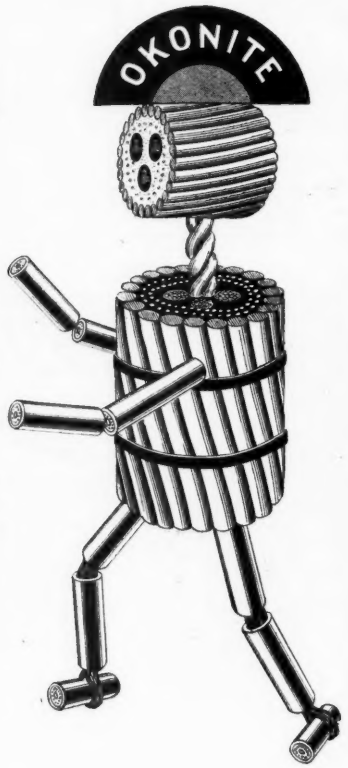

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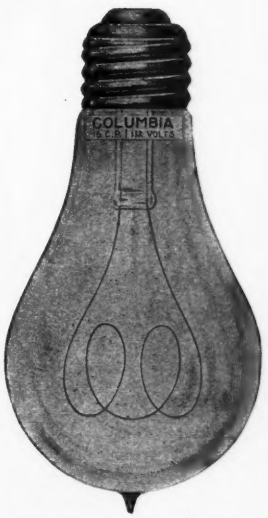

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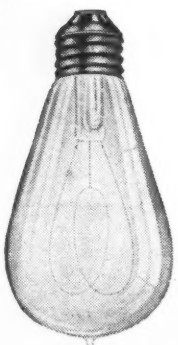

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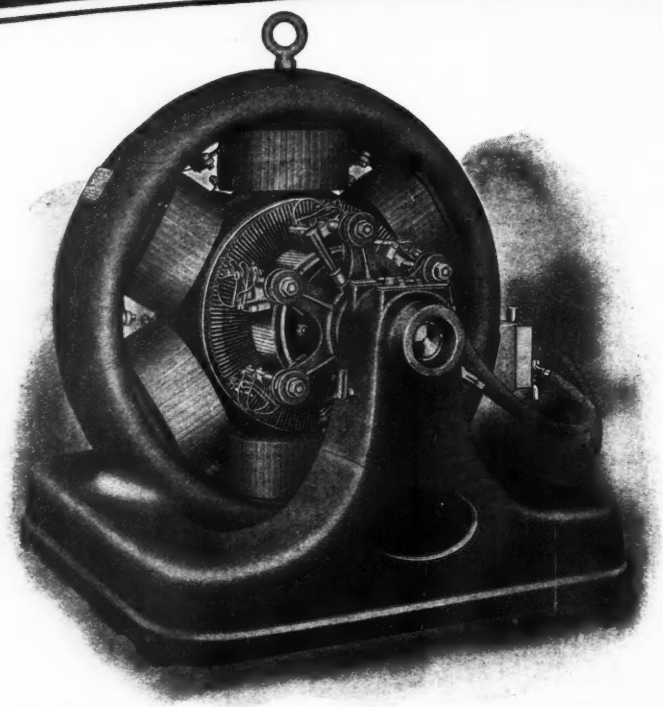

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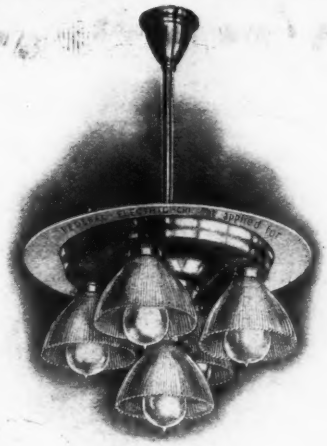

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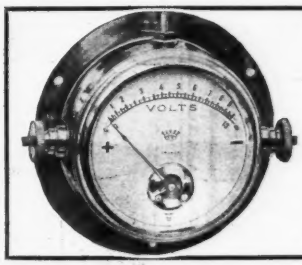

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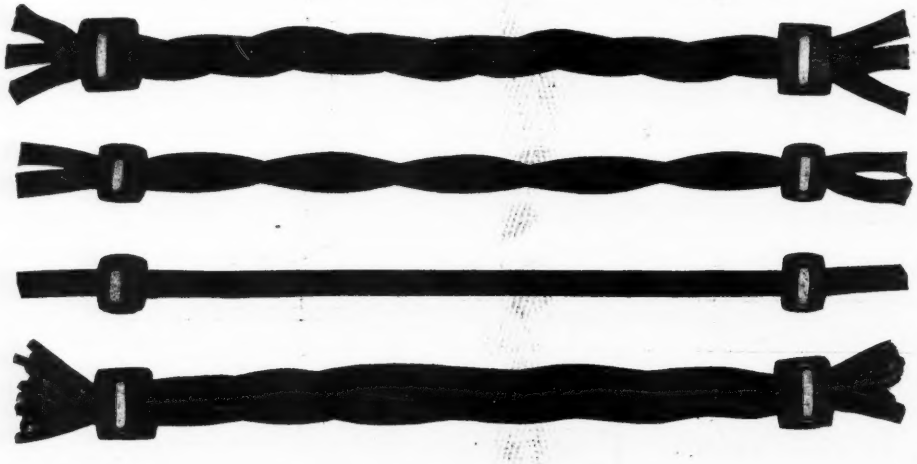

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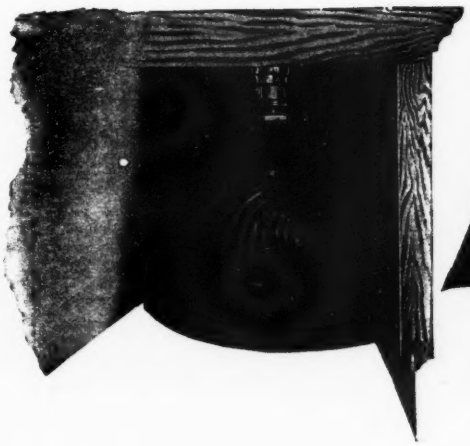

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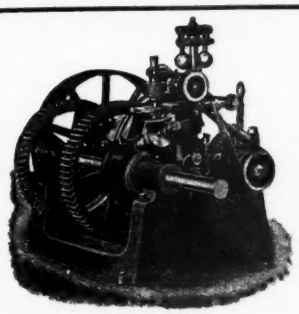

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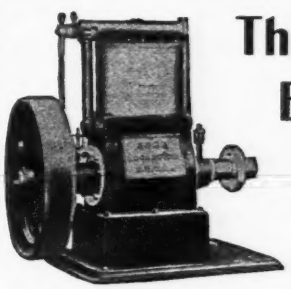

The Acme Engine

Rochester Machine Tool Works
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Rochester, N.Y., U.S.A.
(2)

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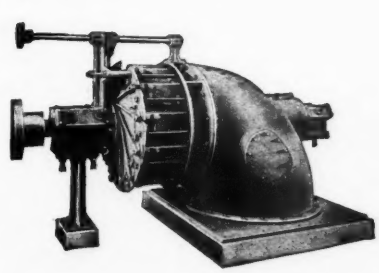

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15-16	13.50	104	235	304	84.60 " "
7-8	13.79	101	223	296	85.01 " "
13-16	14.18	100	209	280	83.56 " "
3-4	14.69	100	189	254	81.06 " "
11-16	15.12	102	174	239	80.36 " "

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Lighting and Illuminating Engineering Number

WITH TUNGSTEN AND TANTALUM LAMP SECTION

SEPTEMBER 12, 1908

ELECTRICAL REVIEW

THE value of the LIGHTING AND ILLUMINATING ENGINEERING NUMBER of the ELECTRICAL REVIEW, published September 14, 1907, was such that it has been recognized during the period since that date as the most comprehensive compendium of concise information on the subjects, and it is being used at this time as a standard of reference. Although a greatly increased edition of that number was published, the demand was so great that within ten days of date of publication all reserved copies had been sold, and copies are in demand at this moment to such an extent that warrants the belief that the forthcoming number will be received with great interest.

In this first number the following is a partial list of contributors:

Dr. Louis Bell, one of the first authorities on Illuminating Engineering; S. E. Doane, Chief Engineer National Electric Lamp Association; Francis W. Willcox, Assistant Manager Incandescent Lamp Department, General Electric Company; V. R. Lansingh, known for his advanced practice and scientific knowledge of illumination, also Engineer of the Holophane Company; J. H. Hallberg, Consulting Engineer, New York City; Walter G. Clark, Codiscoverer of the Helion Lamp; Paul McJunkin; Thos. Spencer, Chief Engineer Helios Mfg. Company; Dr. Edward P. Hyde, Physicist, National Bureau of Standards; Bassett Jones, Jr.; Preston S. Millar, Electrical Testing Laboratories; Otto Foell, Chief Engineer Nernst Lamp Company; Percy H. Thomas, Chief Engineer Cooper Hewitt Electric Company; G. Brewer Griffin; D. McFarlan Moore, Chief Engineer Moore Electrical Company; H. W. Young, Engineer Westinghouse Electric & Mfg. Company; Chas. A. Parker, well known in connection with commercial development of central stations, and others.

The SECOND ANNUAL NUMBER, to be published September 12, 1908, covering this rapidly advancing realm of electrical engineering, will exceed in elaborateness the first number of the ELECTRICAL REVIEW devoted to these subjects.

For this section the co-operation of the highest authorities has been assured the Editors for the assembling of all the information relative to the engineering and commercial accomplishments in Tungsten and Tantalum Lamps. This data will be presented in a condensed and systematic manner, so that the engineers and commercial men interested in light and illumination may have this subject before them in a complete and authoritative form.

Tungsten and Tantalum Lamp Section

Central Stations are confronted by the greatest advance in Tungsten and Tantalum Lamps known since electric light was installed.

How to benefit by the Tungsten and Tantalum Lamps.

These are the questions for which data will be furnished.

It will be the first time such a publication has been made, giving, as it will give, all sides of the subject, by the men through whom these new types of incandescent lamps are being brought to engineering and commercial success.

Progress in Flaming and Carbon Arc Lamps

The work now being done in these important branches will be presented by well-known men. The success of the Flaming Arc for certain services will be demonstrated, and the progress in construction and maintenance of the Flaming Arc Lamp, as well as of the older forms of arc lamps, will be shown.

Standard Carbon Incandescent Lamps, also Osmium, Helion, Titanium, Nernst, Mercury Vapor and Tube Lighting

During the past twelve months a vast deal of engineering and laboratory study has been given these forms of incandescent lighting, while special methods of lighting have received special attention more than ever before in the same length of time. This work will be summarized in articles indicating the several lines along which developments have been made and pointing out the possible directions in which further research and experimentation will increase their efficiency, lower the cost of production and make them of greater adaptability.

Proper Illumination as Important as Producing Light

The recognition accorded illumination is a rapidly growing factor. The application of light, as well as its production, is of prime importance. Especial consideration will be given to the newer phases of this subject. Possibly no other single subject is receiving so much attention at this time, so that it is important that the electrical engineer and, in fact, everyone interested in the use of electricity for illumination secure the best information available.

Central Station Operation and Engineering Practice

A discussion of all the branches of central station engineering practice will form an important part of this number, particular attention being given modern generators and engines, boiler installations, new features in steam equipments, switchboard work, motor service, line construction, etc., etc., etc.

Commercial Development of Central Stations

During the past two years the ELECTRICAL REVIEW has maintained a department in which practical ideas as to methods of getting new business by central stations have been so worked out that thousands of central stations have found suggestive ideas. In view of the generally recognized stimulus approaching in commercial matters, the consensus of opinion appears to be that central stations will realize a material increase in the sale of current during the coming months.

This department in the forthcoming number will be especially prepared with the idea of advancing plans adapted to meet the immediate conditions confronting central stations desirous of greater commercial development.

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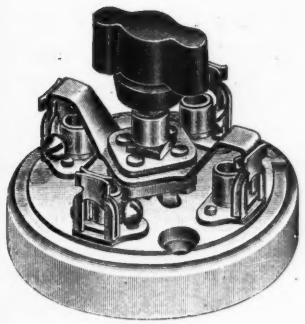

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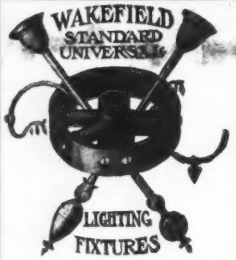

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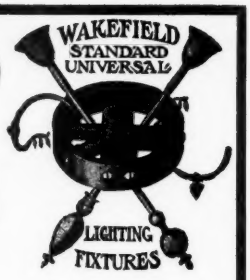

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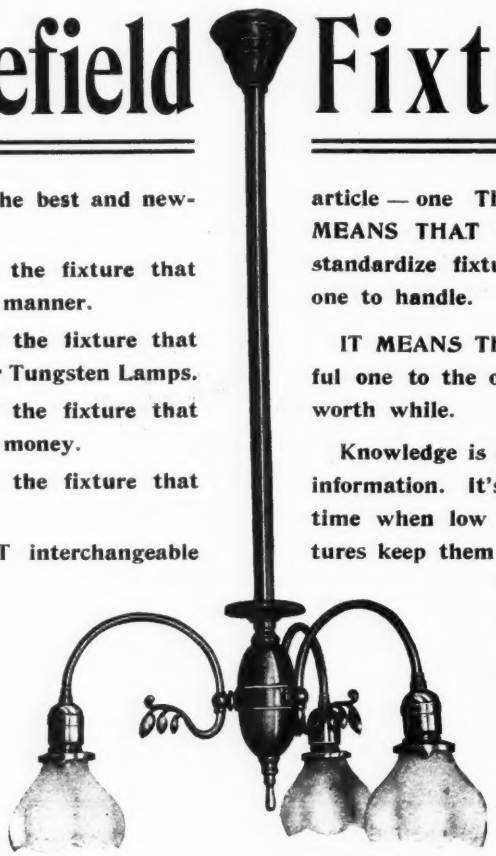

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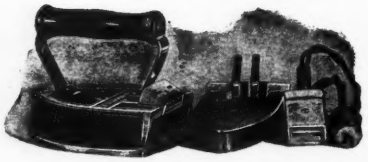

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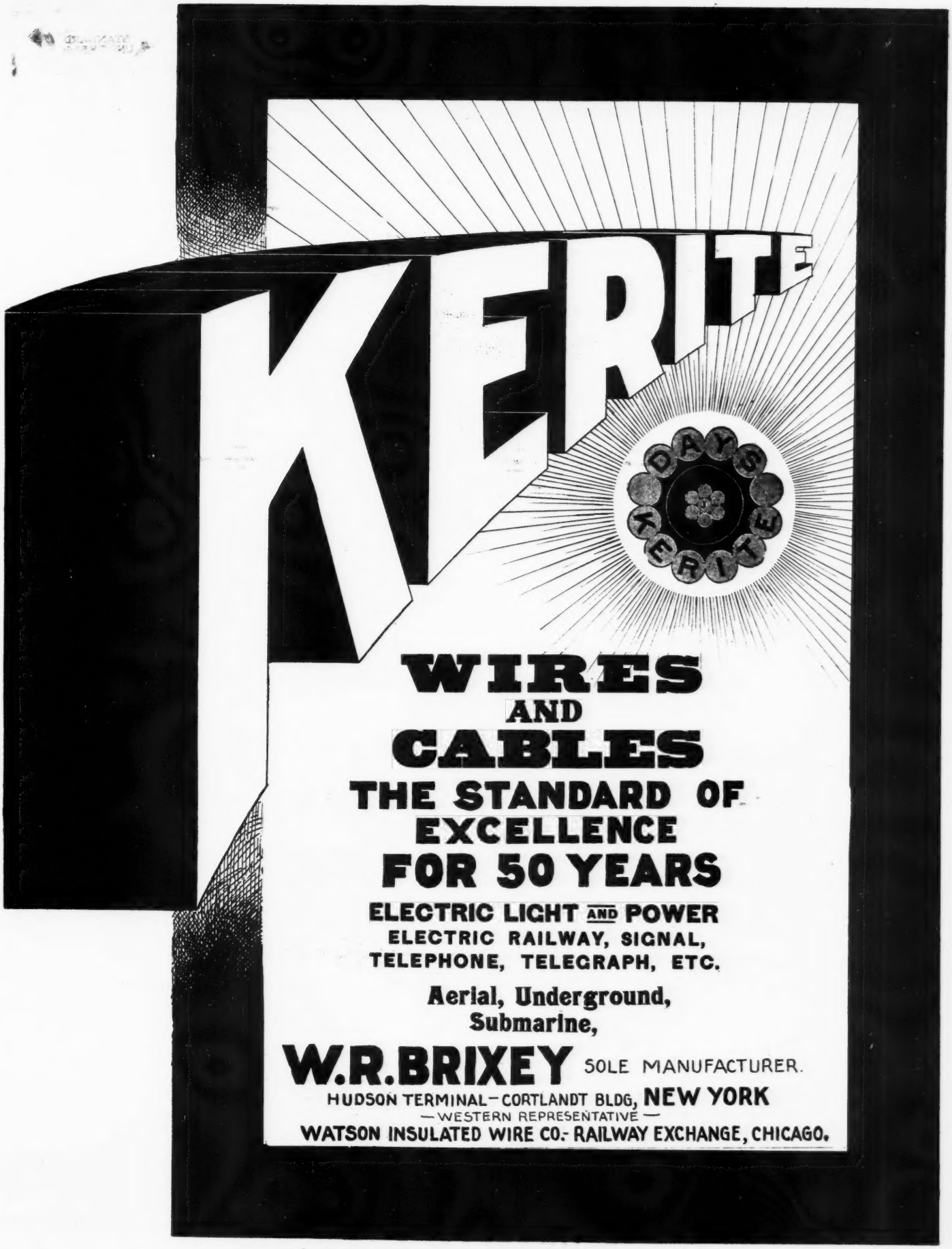

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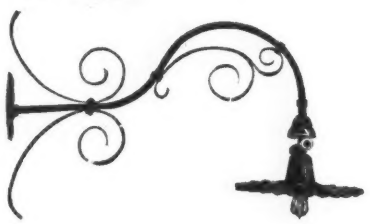
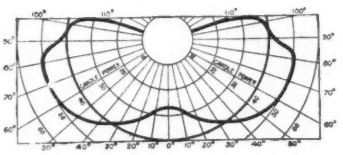


GE Tungsten Lamps will increase the lighting capacity of your regulating apparatus by more than 100 per cent.



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FIXTURES (ELECTRIC)
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Benjamin Electric Mfg. Co.
Dale Co.
Federal Electric Co.
Wakefield Brass Co., F. W.

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Bissell Co., The F.

FLEXIBLE COUPLINGS FOR SHAFTS
The Electric Controller & Supply Co

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Standard Paint Co.

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D & W Fuse Co.
General Electric Co.
Johns-Manville Co., H. W.
Lawrence Electric Co., F. D.
Sachs Co., The

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Chicago Fuse Wire Mfg. Co.

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Triumph Electric Co.
Warren Electric Mfg. Co.
Western Electric Co.

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Holophane Co.
Phœnix Glass Co.

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Ward Leonard Electric Co.

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Brown Hoisting Machinery Co.
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HYDRAULIC MACHINERY
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IMPREGNATING COMPOUND
Mitchell, W. E. G.

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Rœntgen Mfg. Co.

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Macbeth-Evans Glass Co
Phœnix Glass Co.

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Duncan Electric Mfg. Co.
Eldredge Electric Mfg. Co.
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General Electric Co.
International Electric Meter Co.
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Wagner Electric Mfg. Co.
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Western Electric Co.
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Minerallac Co.
Mitchell, W. E. G.

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New England Butt Co.

INSULATING PAINTS
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Elm City Engineering Co.
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Okonite Co.
Standard Paint Co.
Standard Underground Cable Co.
Thomas & Sons, R.

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General Electric Co.
Queen & Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

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General Electric Co.

LAMPS, INCANDESCENT
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Brilliant Electric Co.
Bryan Marsh Co.
Buckeye Electric Co.
Central Electric Co.
Columbia Incandescent Lamp Co.
Colonial Electric Co.
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Economy Electric Co.
Efandam Co.
Fort Wayne Electric Works
Fostoria Incandescent Lamp Co.
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(*Continued on page 52*)

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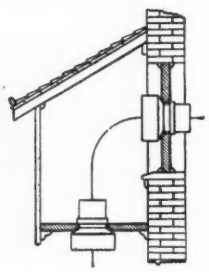

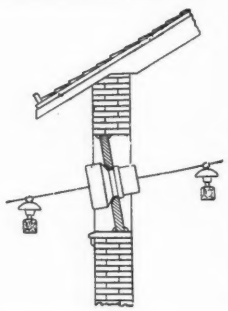

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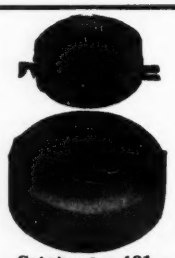

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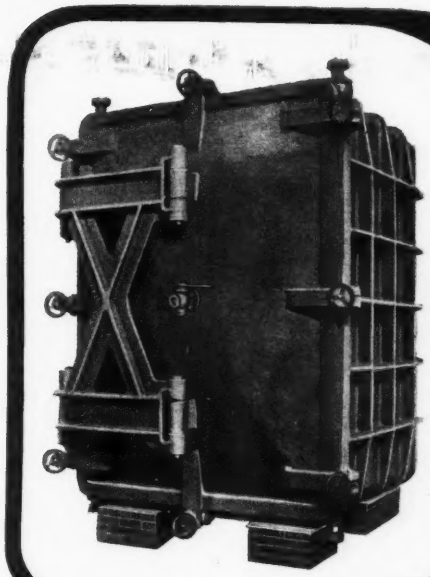

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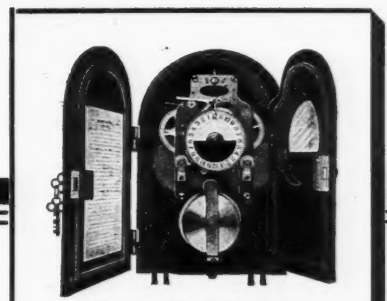
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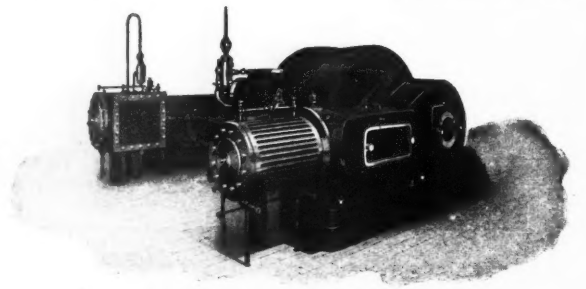

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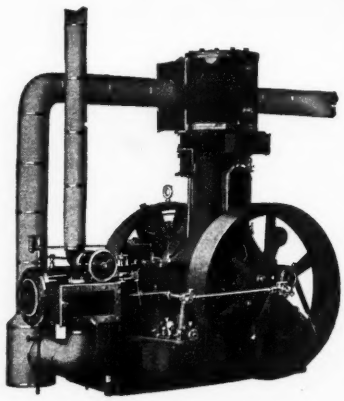

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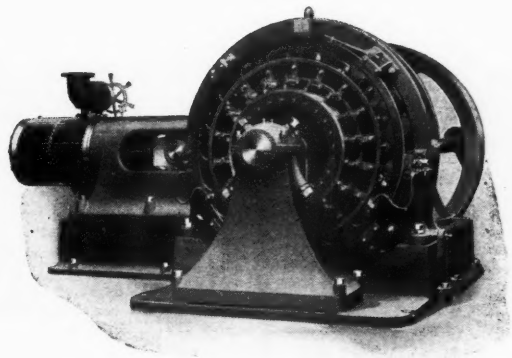

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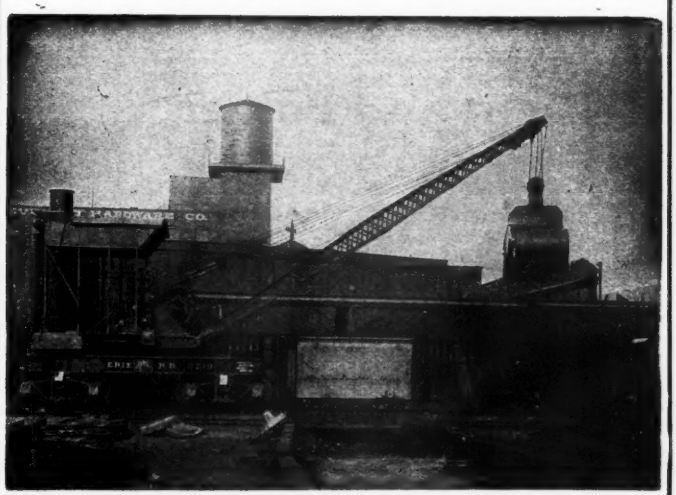

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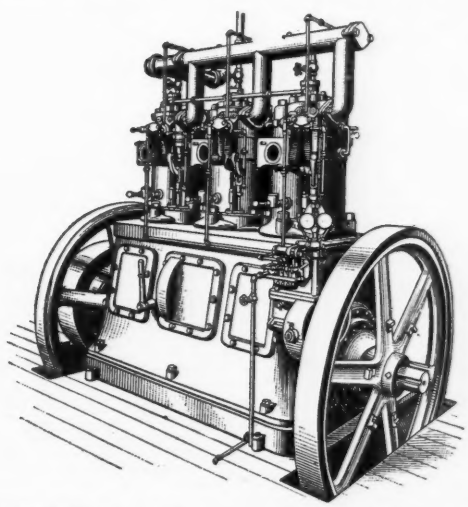

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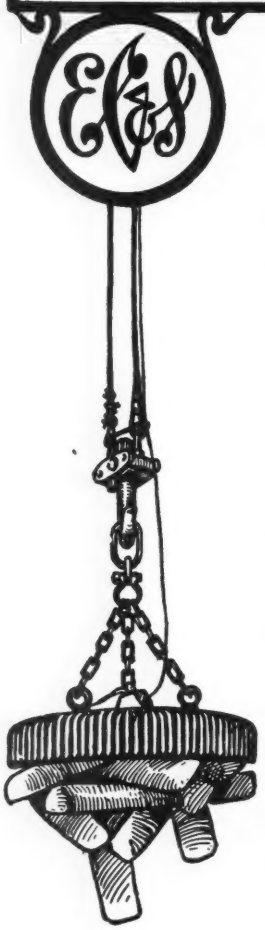

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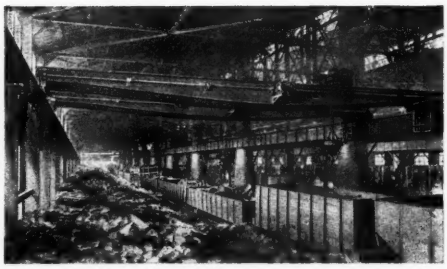

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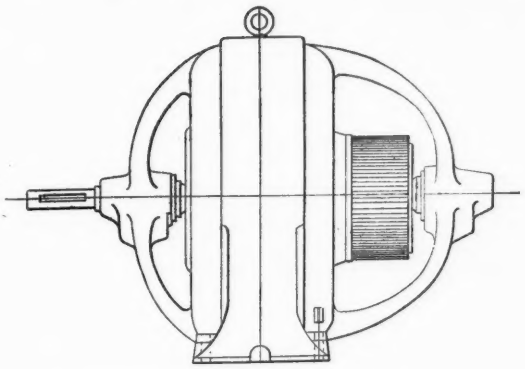

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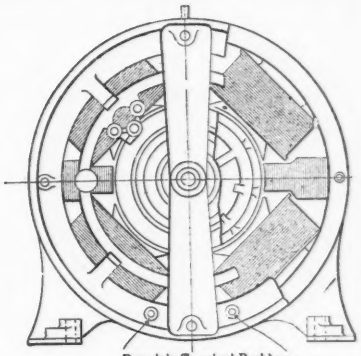

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H. P.	Ratio	Speed
1	5 : 1	300–1500
	4 : 1	500–2000
	3 : 1	300–1200
	2 : 1	500–1500
		300– 900
		500–1000
		300– 600
1½	5 : 1	450–2250
	4 : 1	250–1250
	3 : 1	450–1800
	2 : 1	250–1000
		800–2400
		450–1350
		800–1600
2	5 : 1	350–1750
	4 : 1	240–1250
	3 : 1	350–1400
	2 : 1	240– 960
		600–1800
		350–1050
		1000–2000
		600–1200
3	5 : 1	350–1750
	4 : 1	225–1125
	3 : 1	350–1400
	2 : 1	500–2000
		500–1500
		350–1050
		900–1800
		500–1000
4	5 : 1	300–1500
	4 : 1	200–1000
	3 : 1	475–1900
	2 : 1	300–1200
		475–1425
		650–1950
		650–1300
		475– 950
5	5 : 1	375–1875
	4 : 1	250–1250
	3 : 1	375–1500
	2 : 1	250–1000
		600–1800
		375–1125
		850–1700
		600–1200
7½	5 : 1	275–1375
	4 : 1	200–1000
	3 : 1	350–1400
	2 : 1	275–1100
		550–1650
		350–1050
		900–1800
		550–1100
10	5 : 1	350–1750
	4 : 1	250–1250
	3 : 1	350–1400
	2 : 1	250–1000
		500–1500
		350–1050
		750–1500
		500–1000
15	5 : 1	325–1625
	4 : 1	200–1000
	3 : 1	400–1600
	2 : 1	325–1300
		400–1200
		325– 975
		750–1500
		550–1100
20	5 : 1	275–1375
	4 : 1	175– 875
	3 : 1	425–1700
	2 : 1	275–1100
		425–1275
		525–1575
		700–1400
		950–1900
25	5 : 1	200–1000
	4 : 1	350–1400
	3 : 1	200– 800
	2 : 1	550–1650
		350–1050
		650–1300
		550–1100
30	5 : 1	250–1250
	4 : 1	120– 600
	3 : 1	250–1000
	2 : 1	120– 485
		425–1275
		250– 750
		650–1300
		425– 850
40	5 : 1	
	4 : 1	160– 640
	3 : 1	360–1080
	2 : 1	160– 480
		575–1150
		360– 720
50	5 : 1	
	4 : 1	135– 540
	3 : 1	200– 600
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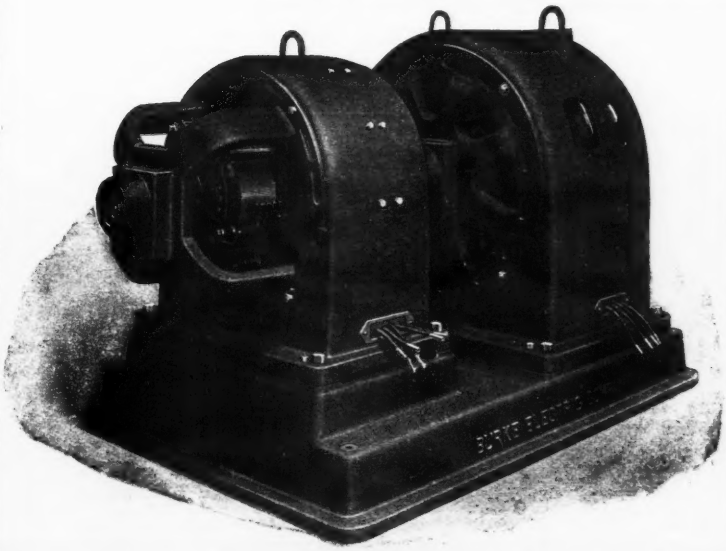

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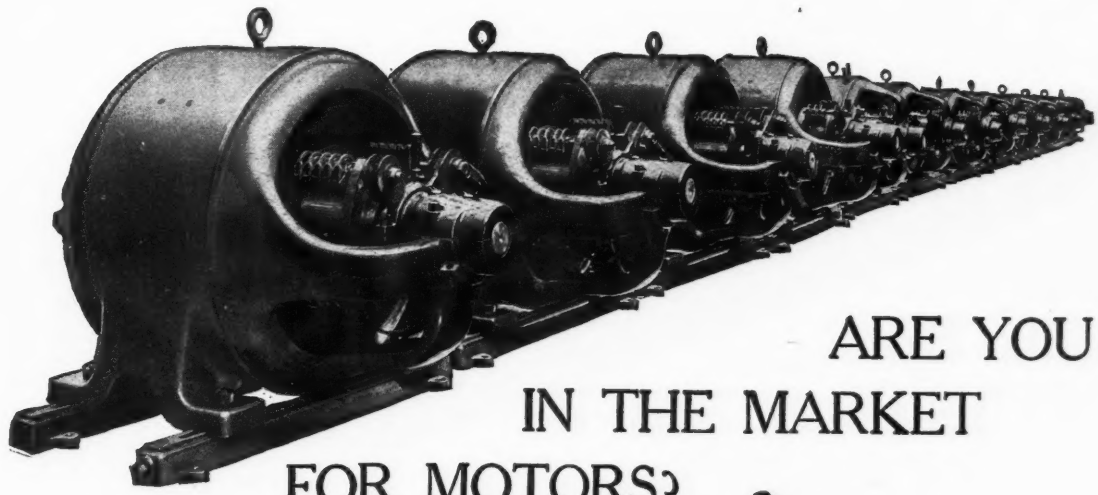

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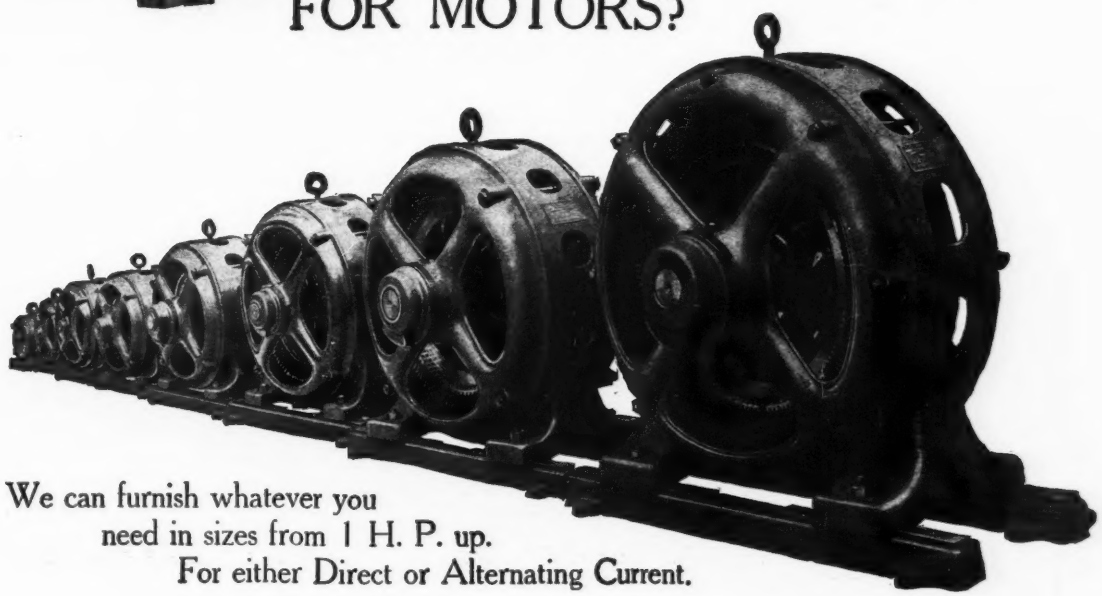

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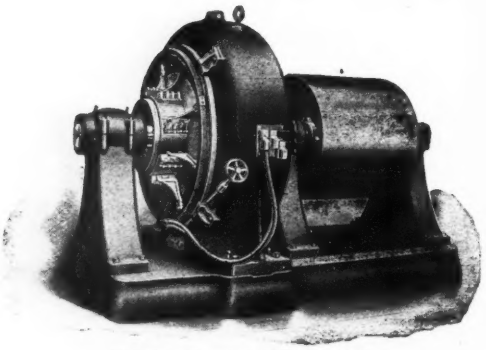

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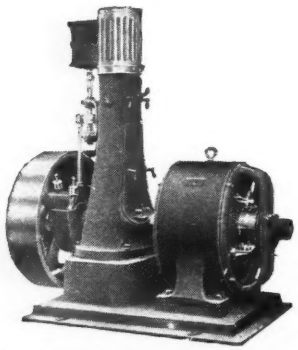
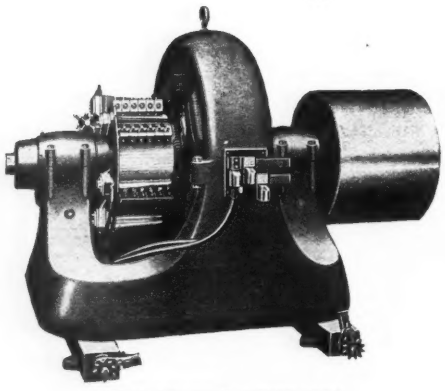


MARINE TYPE GENERATOR



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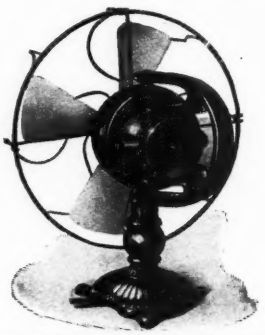

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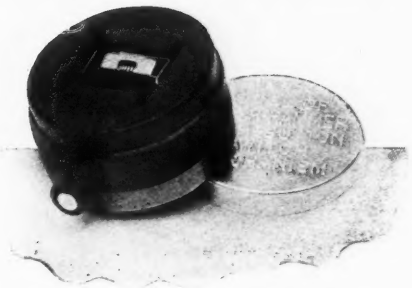
CUTLER-HAMMER

READY NEXT WEEK



MODEL OF CUTLER-HAMMER
PUSH-BUTTON SWITCH MECHANISM

Free on request while they last to those who use business stationery. We shall be obliged to short-circuit postal card requests.

Next week the booklet descriptive of the new line of Cutler-Hammer snap switches and lamp sockets will be ready for distribution. Those who have already made application for a copy will receive in addition to the booklet a working model of the wonderfully simple mechanism that places these specialties in a class by themselves.

Think of a switch that *makes* and breaks the circuit with a positive, quick snap, and that consists of *only three moving parts:*

1. A push bar extending clear through the switch

2. A coiled steel spring

and

3. A metal contactor

The working model shows how these three pieces are assembled in the switch —shows how they work.

You will admit when you see it that it is the cleverest and simplest switch mechanism yet invented.

Illustrated booklet descriptive of Cutler-Hammer push-button specialties ready for distribution next week, together with list prices and discounts. We cannot promise to send a working model of the switch mechanism to everyone, but we will send them out (first come, first served) as long as our supply lasts. Those who write for the booklet and model *to-day* may be reasonably sure of receiving both. Save time by addressing nearest office.

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Overall Diameter, 3 Inches
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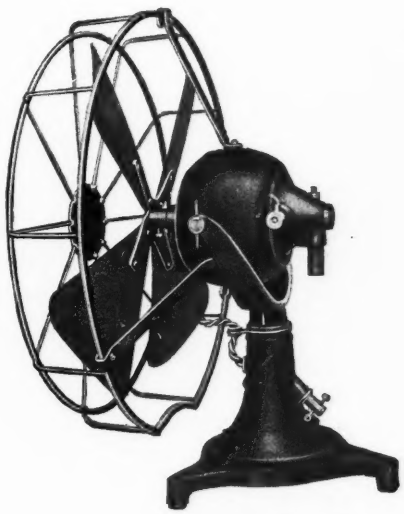

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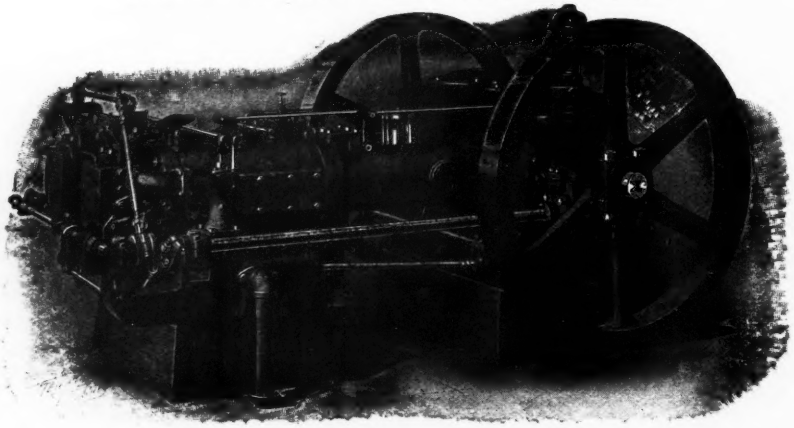

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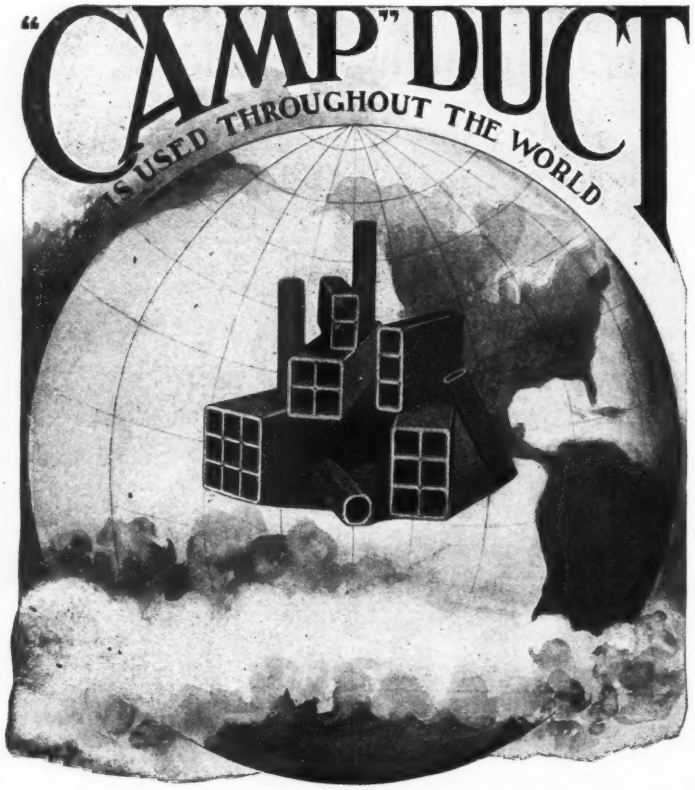

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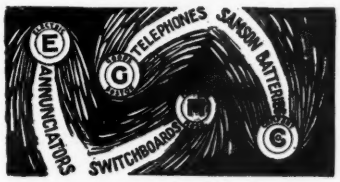

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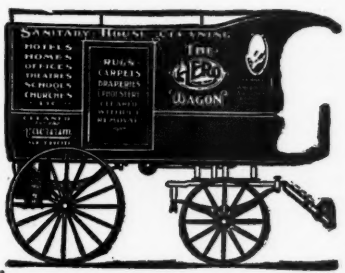

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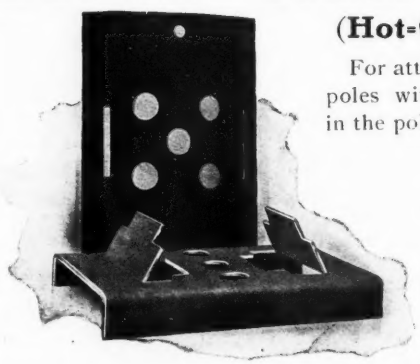

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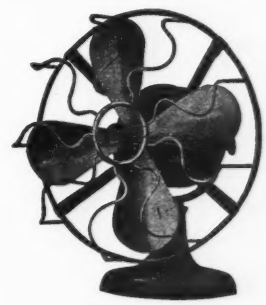

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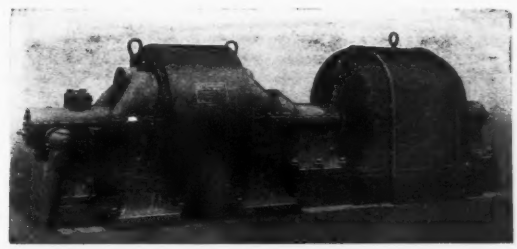

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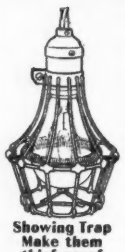

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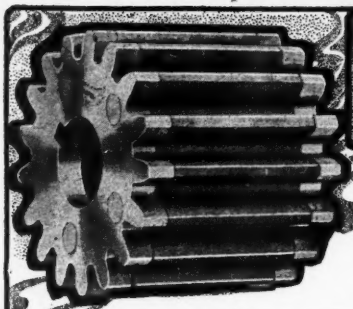

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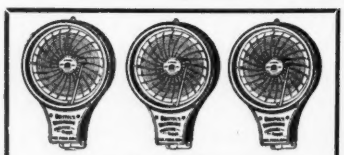

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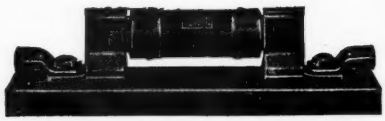
Contacts of all **SHAWMUT** Fuse Bases above 60 amp. are made without use of castings. Drawn copper gives maximum conductivity.



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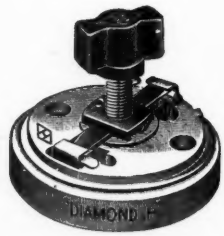

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No matter what your wants are in Enclosed Fuses we can meet the demand in Amperes, Voltage and current capacity. FUSE MANUFACTURERS for 20 years. Our entire line 250 and 600 volt approved by Underwriters' Laboratories.

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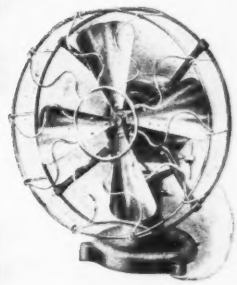

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(1)

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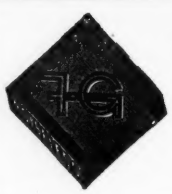

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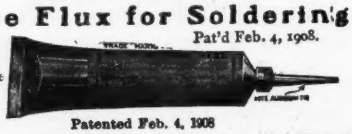

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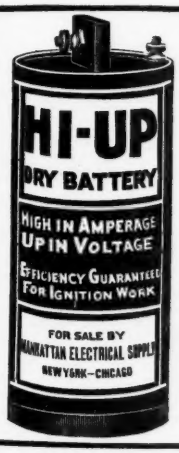

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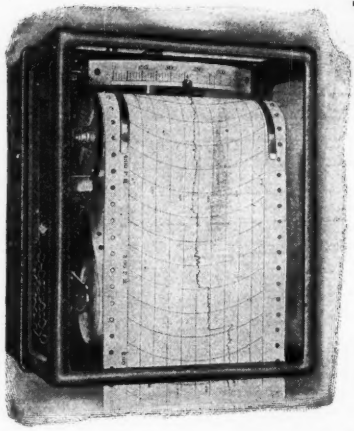

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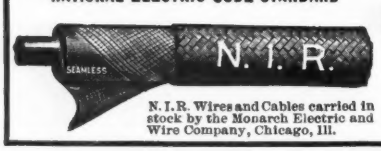

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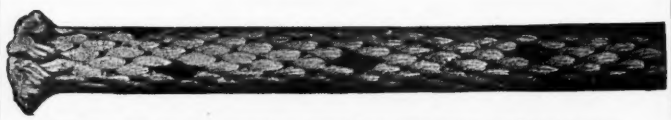

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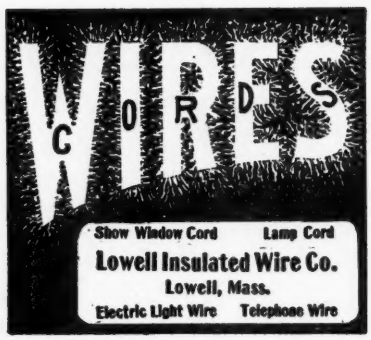

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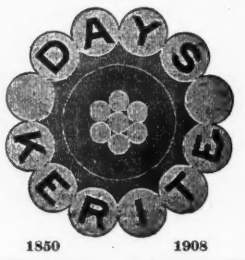


KERITE insulation is a homogeneous combination of crude Kerite with the finest Para rubber. Kerite preserves the rubber and has unequaled life and durability. This has been *proved* by the actual test of fifty years.

¶ Initial tests determine if an insulated wire will do the work for which it is intended; *but* initial tests can *not* determine if it will do that work years hence. Kerite has back of it an unequaled record of half a century of successful service under the most adverse conditions.

¶ Kerite insulation does not deteriorate, but improves with age.

KERITE wires and cables installed half a century ago are in service today. The wonderful durability of Kerite insures the highest efficiency, safety and economy, and is a guarantee of the best and most successful results.

¶ The property of Kerite in resisting deteriorating influences and the qualities which render it so indestructible are facts which should be carefully considered where an insulated wire is used.

¶ Take advantage of the experience of others and insure your service with Kerite.

For Fifty Years the Standard of Excellence

AERIAL—UNDERGROUND—SUBMARINE

W. R. BRIXEY

SOLE MANUFACTURER

Hudson Terminal, 30 Church Street, New York

Western Representative: WATSON INSULATED WIRE CO., Railway Exchange, Chicago, Illinois.

Good at All Times

OKONITE WIRES

OKONITE CABLES

OKONITE TAPE

MANSON TAPE

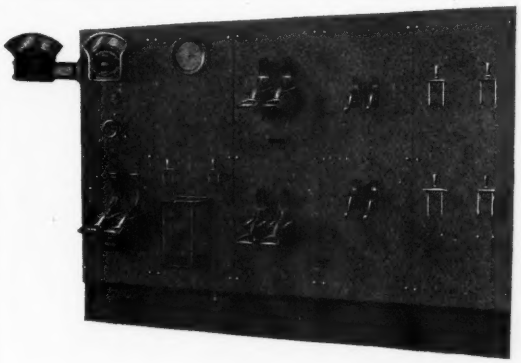
No matter how severe the change in temperature, it will not affect Okonite Insulated Wires and Cables. Okonite insulation is not affected either electrically or mechanically, no matter what the climatic conditions may be.

Okonite Insulated Wires and Cables are endorsed by the best electrical authorities, and are sure to appeal to you if you want the *best* for your money.

The Standard for Rubber Insulation

Central Electric Company, 264-266-268-270 FIFTH AVE., **CHICAGO**

General Western Agents



The Switchboard Bulletin we issue, telling about

BISSELL SWITCHBOARDS

and their prices, will be of the greatest assistance to you in the purchase of the most efficient switchboard on the market. *Shall we send the Bulletin?*

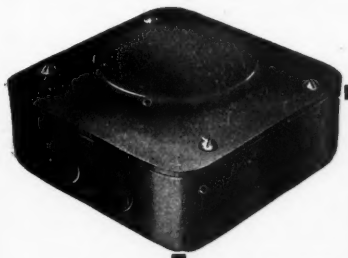
THE F. BISSELL COMPANY, TOLEDO, O.

SWITCHBOARDS PANEL-BOARDS

It will pay you to investigate our line of panel-boards, switchboards and steel cabinets. We have built a great many and **never failed to satisfy. Try us** and be convinced. SATISFACTION GUARANTEED.

EATON ELECTRIC MFG. CO.

144 EAST ERIE STREET **CHICAGO**



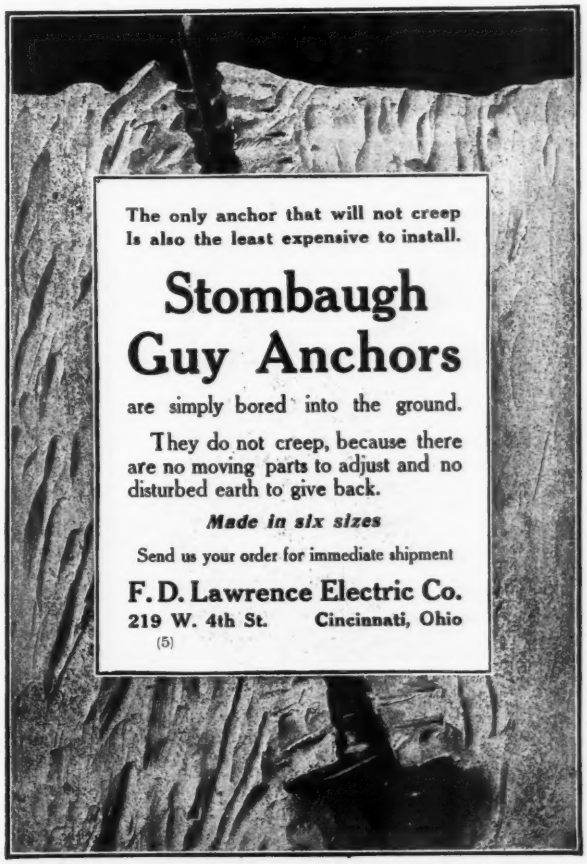
We not only claim but can prove that

BOSSERT BOXES

Are the most economical, the strongest, and the best for all purposes. One blow of the hammer produces a clean, round hole in a second. We make all styles for every purpose. **Write us today.**

BOSSERT ELECTRIC CONSTRUCTION CO.

UTICA, N. Y. 4



The only anchor that will not creep Is also the least expensive to install.

Stombaugh Guy Anchors

are simply bored into the ground.

They do not creep, because there are no moving parts to adjust and no disturbed earth to give back.

Made in six sizes

Send us your order for immediate shipment

F. D. Lawrence Electric Co.

219 W. 4th St. **Cincinnati, Ohio**

(5)

FORT WAYNE ELECTRIC WORKS
"WOOD" SYSTEMS

Single-Phase Type K Wattmeter

Type K Wattmeters

Every possible condition to be met with in wattmeter service has been sought out and is successfully provided for in the design of the Type K Wattmeter.

"They can't be beat."
True in more ways than one.
Ask for Type K Meter Bulletin

751

Sales Offices
Atlanta, Boston, Cincinnati, Chicago, Grand Rapids, New Orleans, New York

Main Office
Fort Wayne, Ind.

Sales Offices
Pittsburg, Philadelphia, St. Louis, St. Paul, San Francisco, Syracuse, Seattle

See our Exhibit at the Electrical Show, Chicago, January 16 to 30, 1909

HAVE YOU TRIED

the newest and latest design of

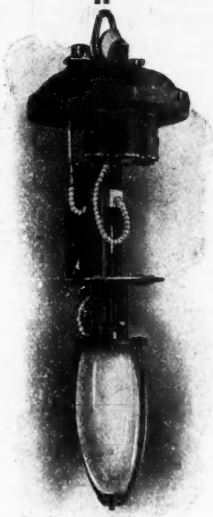
DUNCAN METER
FOR DIRECT CURRENTS?

For appearance, accuracy and up-to-date qualities it discounts all attempts that have heretofore been made in this line.

Descriptive bulletin now in press. Write to us for a copy.

DUNCAN ELECTRIC MANUFACTURING CO.
LAFAYETTE, INDIANA

LAMPS and CARBONS



G. I. Type K Arc Lamp

A great many of the arc lamps on the market give good results for a short time only, due to the fact that they are complicated and soon get out of order, requiring the services of an expert to keep them in good shape. You can readily see that these are very expensive lamps to maintain and unreliable also.

The G. I. Type K Lamp has been in use for fifteen years, and is very simple, composed of few parts and those substantially made.

Columbia Tungsten Lamps

We now carry in stock and can ship promptly the following types of Tungsten Lamps:

25	Watt	Standard	Package,	100	Lamps
40	"	"	"	50	"
60	"	"	"	50	"
100	"	"	"	24	"

Transportation allowed to all points on or east of the Mississippi River when ordered forward in standard packages. Our stock of Tantalum and Carbon Filament, both Standard and Miniature is also complete. Write your requirements.

Siemens' Arc Light Carbons

In the purchase of any carbon the three important things to be considered are: the ash deposit, the life of the carbon, and its uniformity.

Siemens' carbons are the purest possible, and give least ash deposit, because the soot used in them is produced by the imperfect combustion of tar, pitch, oils and rosins, while other carbons depend on gas retorts, or petroleum coke; neither of which is as pure. This purity combined with the great care used by the manufacturer in making them true to gauge is also a guarantee of long life and absolute uniformity. Let us send you samples and prove our claims.

All of the above are fully described in our 1909 Catalogue. If you did not receive a copy write for one

Central Electric Company, ELECTRICAL SUPPLIES
264-266-268-270 Fifth Avenue, CHICAGO

A STORAGE BATTERY METER

Everyone interested in the efficient use of storage batteries will welcome the

SANGAMO
AMPERE-HOUR METER

A mercury-motor integrating meter of the same general design and appearance as our well-known SANGAMO WATTMETERS, but modified and specially designed for use with

ELECTRIC VEHICLES
RAILWAY CAR-LIGHTING EQUIPMENT
CENTRAL-STATION BATTERIES

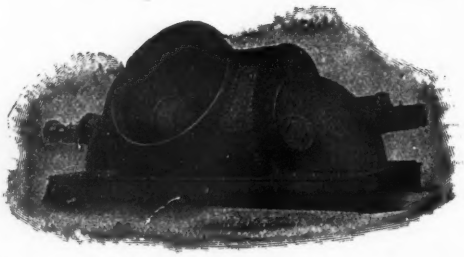
The position of a large dial hand shows the exact condition of a battery with respect to full charge at any moment.

Write for Descriptive Bulletin No. 14, just issued

WATCH FOR FURTHER ADVERTISEMENTS AND DESCRIPTION OF THIS METER IN ELECTRICAL, RAILWAY AND AUTOMOBILE JOURNALS.

SANGAMO ELECTRIC COMPANY
SPRINGFIELD, ILLINOIS

McCORMICK TURBINES



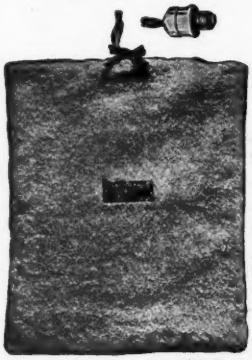
both Cylinder and Wicket Gate, giving **ENORMOUS** power, are used in hundreds of electric power plants throughout the world.

We make a specialty of designing Turbines to meet the requirements of the public.

We build Francis Turbines in spiral flumes to operate under high heads.

S. MORGAN SMITH COMPANY, York, Pa., U. S. A.
Branch Office: 176 Federal Street, BOSTON, MASS.

SIMPLEX QUALITY



MANY people use an Electric Heating Pad practically every night through the winter to warm up the bedclothes before retiring. Then too, the cold, wet season aggravates ills, like neuralgia, that the heating pad does so much to relieve. Altogether, the time is now at hand when these articles can be most readily introduced. The stations that begin early will get the revenue from them all winter. Remember, Simplex Pads have given the best satisfaction for years. Write for terms.

SIMPLEX ELECTRIC HEATING CO.
CAMBRIDGE, MASS.
Monadnock Block - - CHICAGO

PASSBURG
Vacuum Drying and Impregnating Apparatus

FOR TRANSFORMER, FIELD and ARMATURE COILS, ELECTRIC CABLES, Etc.

Absolute Dryness—No Overheating
No Fire Hazard—Operative Economy
Great Durability

All Types All Sizes

J. P. DEVINE CO., - Buffalo, N. Y.

EDISON
PRIMARY BATTERIES

You need buy a set of Edison cells but once—after that you get Edison service at merely the cost of Edison renewals. Edison Primary Batteries will answer every electrical purpose.

Write for information covering your need

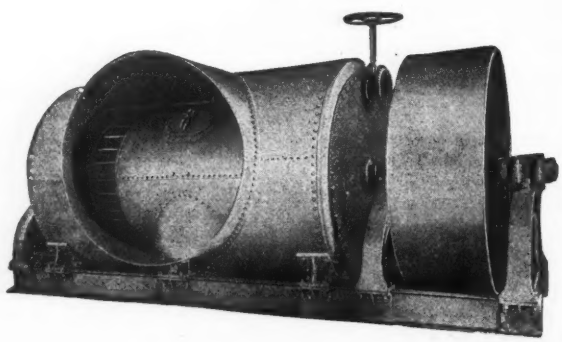
Edison Manufacturing Company
3 Lakeside Avenue, Orange, N. J.
Victoria Road, Willesden, London, N. W.

FIVE GOOD BOOKS

NEW DYNAMO TENDERS' HAND-BOOK.
INCANDESCENT WIRING HAND-BOOK.
BELL HANGERS' HAND-BOOK.
ELECTRIC TRANSMISSION HAND-BOOK.
TELEPHONE HAND-BOOK.

ELECTRICAL REVIEW PUB. CO.
Suite 507 Marquette Building - CHICAGO, ILL.

ONE DOLLAR EACH.



SAMSON TURBINE

To insure close speed regulation in a turbine it is necessary to have a gate which is easily operated. The gates on our SAMSON TURBINES are balanced and consequently moved with the greatest ease.

JAMES LEFFEL & CO., No. 309 Lagonda Street SPRINGFIELD, OHIO, U.S.A.

12

"H & H" SWITCHES & RECEPTACLES

ENABLE THE CONTRACTOR TO DEFY COMPETITION

YOU CAN "CINCH" EVERY CONTRACT
YOU CAN DO A BETTER JOB OF WIRING
YOUR CUSTOMERS WILL BE BETTER SATISFIED
YOU WILL INCREASE YOUR BUSINESS

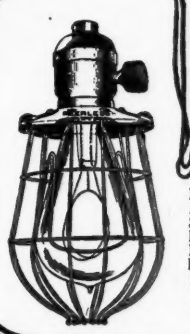
Why not take advantage of high quality at prices that enable you to increase your profits? ¶ Your order, no matter how small, will be promptly attended to, as we are anxious to prove their superiority.

Catalog "F" is yours for the asking

THE HART AND HEGEMAN MFG. CO.

92 Capitol Avenue Hartford, Conn.

(2)



GREENWOOD'S *Peerless* LAMP GUARD

Always retains its shape.

No broken lamps where Peerless Guards are used.
Absolute rigidity. Will not bend or break.
Superior to any other Guard on the market.
Easily applied without the use of tools.
Practically indestructible.
Indorsed by the Underwriters.
Made to fit all styles of sockets.
Write for circulars and prices.
For sale by all up-to-date dealers.

Greenwood Mfg. & Supply Co., 141 Milk St., Boston

KLEIN'S Always Reliable

FOR HEAVY PULLING

"SAMSON GRIP"

GET THE HABIT TO "SPECIFY KLEIN'S" and No. 363-S FOR STRAND WIRE No. 363-B FOR TROLLEY WIRE

YOU WILL NEVER USE OTHERS

Write for a Copy of Our Catalog

Mathias Klein & Sons 81 W. Van Buren St., Chicago TOOLS

HEADQUARTERS FOR THE BEST OF EVERYTHING IN

ELECTRIC LIGHTING SUPPLIES

Wires, Cords, Cables, Cut-Outs, Arc Lamps, Switches, Globes
Sockets, Brushes, Dynamos, Dynamo Parts, Cored and Solid Carbons, Electric Fans
Electric Heating and Cooking Utensils, Motors, HYLO Lamps
Miniature Decorative and all kinds of Incandescent Lamps, Electric Portable Lamps for Office Use

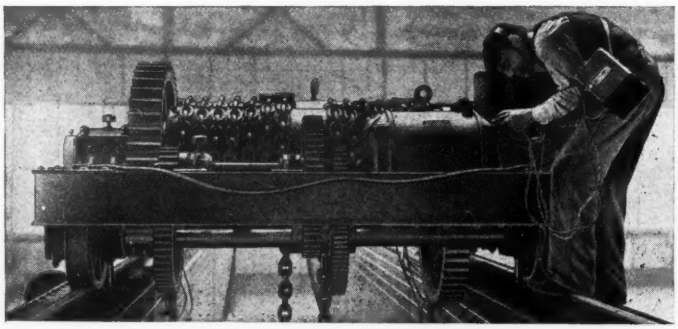
COMMONWEALTH EDISON COMPANY
ELECTRIC LIGHT AND POWER

Telephone Main 1280 Edison Building, 139 Adams Street, CHICAGO

This Is What You Need

The Electric Fault Finder

¶ For detecting and locating grounds, short circuits, open circuits leaks and other faults in armature coils, field coils, control circuits, switchboard wiring or any other electricial circuit.



Note the portable and one-man features]

¶ Only one man needed to operate it.
¶ No outside current required.
¶ Portable.
¶ Small,
and costs only

$35.00

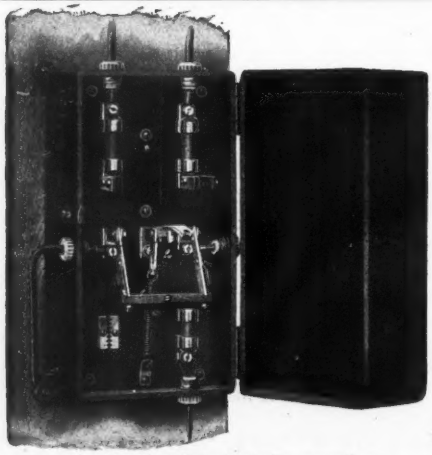
¶ Let a FAULT FINDER locate that trouble for you and save time—labor—and your temper.

¶ Why do three times the necessary work when locating that faulty circuit?

SEND FOR BOOKLET

The Electric Controller & Mfg. Co.

CLEVELAND, OHIO



Showing M. & R. Cut-out after operating.

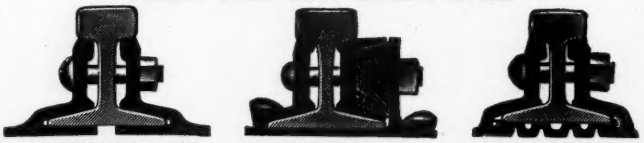
Protect yourself and family, also your buildings, by installing one of our

ELECTRIC SAFETY VALVES

For prices, etc., address

ELECTRICAL MFG. CO.
OSHKOSH, WIS.

OVER 50,000 MILES IN USE
ROLLED FROM BEST QUALITY STEEL



CONTINUOUS JOINT WEBER JOINT WOLHAUPTER JOINT

THE RAIL JOINT COMPANY
GENERAL OFFICES, 29 WEST 34TH ST., NEW YORK CITY

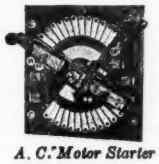
Makers of Base Supported Rail Joints for Standard and Special Rail Sections, also Girder, Step or Compromise, and Insulating Rail Joints, protected by Patents in the United States and Foreign Countries.

HIGHEST AWARDS
Paris, 1900; Buffalo, 1901
St. Louis, 1904

Catalog at Agencies
Baltimore, Md.
Boston, Mass.
Chicago, Ill.
Denver, Colo.
Pittsburg, Pa.
San Francisco, Cal.
Seattle, Wash.
St. Louis, Mo.
St. Paul, Minn.
Troy, N. Y.
London, Eng.
Montreal, Can.

CUTLER-HAMMER

IN thousands of industrial plants throughout the country, in steel mills and cotton mills, in foundries and machine shops, in mines, in printing establishments, in apartment houses, hotels and private residences there are electric motors at work—motors that drive pumps, ventilating fans, machine tools, presses, elevators, cranes, laundry machines, ice cream freezers, and an endless number of other labor-saving devices. If it were possible to check over the controllers used with these motors it is probable that a large majority of them would be found to bear the Cutler-Hammer name-plate.



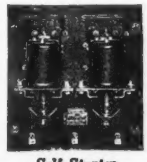
A. C. Motor Starter

* * *

Quite probable.

Because, The Cutler-Hammer Mfg. Co. is the largest producer of electric controlling devices in the world.

Because, the leading motor manufacturers are our best customers, purchasing tens of thousands of starting rheostats and speed regulators yearly for use with motors of their own manufacture.

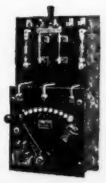


Self-Starter for D. C. Motor

Because, the leading manufacturers of machine tools, ventilating fans, pumps, printing presses, etc., are also good customers of ours, to say nothing of the host of consulting engineers and electrical contractors who specify and purchase Cutler-Hammer controllers.

* * *

No matter what make of motor or motor-driven machine a purchaser buys there is more than an even chance that he will get a Cutler-Hammer controller with it, a fact that is significant as indicating what experts think of Cutler-Hammer apparatus, for there are cheaper controllers on the market—controllers on which the motor manufacturer, or manufacturer of motor-driven machinery, could make a larger profit if he were willing to furnish with his own apparatus any but the best controller made.

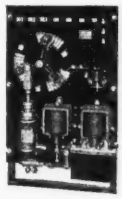


D. C. Motor Starter

* * *

These statements are not mere advertising talk, but facts—facts that the reader can substantiate by inquiry among manufacturers of motors, machine tools, pumps, ventilating fans, printing presses, etc.; by inquiring of consulting engineers and electrical contractors, or by noting for himself the controllers that are mostly used in his own vicinity.

A HEART TO HEART TALK WITH THE MAN IN THE MARKET



Self-Starter for A. C. Motor

* * *

Carry the investigation a little further and inquire of those who are directly interested in some other make of controller, and almost without exception they will tell you that *next to their own apparatus* Cutler-Hammer controllers are the best made.

* * *

The Man in the Market is interested in knowing what products are recognized by experts as the best of their kind. He may not always purchase the best, but he wants to know what *is* best, if only for the purpose of having a standard by which to measure the value of similar products.

Gauge-Type Pressure Regulator used with Self-Starter—Closed Tank Systems

Cutler-Hammer controllers are the standard by which other electric controlling devices are measured. The price lists of competing manufacturers are based on the Cutler-Hammer price list and are in general a tacit admission of the *superior quality* of Cutler-Hammer apparatus.

* * *

If this advertisement induces the reader to investigate for himself the merits of the various lines of controlling devices on the market it will have accomplished its purpose. It is not published with the idea that it will bring any direct response, but in the hope that it *will* induce the occasional purchaser of rheostats to *investigate* before he buys. It isn't difficult to sell Cutler-Hammer controllers to the man who is buying electric controlling devices every day and who knows what's what, but it is heart-breaking to reflect on the number of orders we lose because so many *occasional* purchasers of starting rheostats, speed regulators, self-starters, etc., mistakenly believe that there isn't very much difference between one make of rheostat and another.

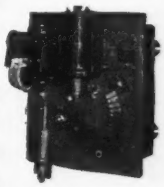
Printing Press Controller

Machine Tool Controller

If we can bring home to the Man in the Market a realization of the fact that all controllers are *not* alike, we shall have taken a long step toward securing that man's business.

* * *

If you are not yet numbered among the users of Cutler-Hammer apparatus, we want you to drop us a line the next time you are in the market for an electric controlling device of any kind, or are confronted with some problem involving the starting, stopping or speed regulation of an electric motor. It will cost you only a two-cent stamp to put your problem up to us, and our suggestions—based on the experience gained in many years of work along this one line—may prove of considerable value to you.



Self-Starters for Electric Elevator

We are always glad to answer such inquiries fully and freely, because we have learned that orders have a way of gravitating to the concern that is never too busy to lend a helping hand to the prospective customer.

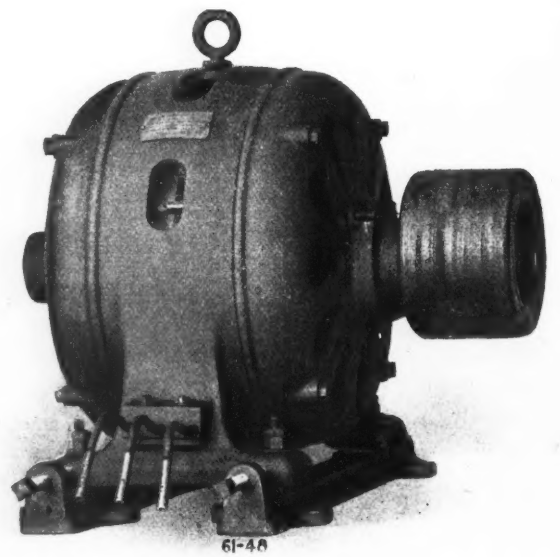
THE CUTLER-HAMMER MFG. CO.
MILWAUKEE, WISCONSIN.
New York Office:
Hudson Terminal, 50 Church St.
Chicago Office.....Monadnock Block
Boston Office.....176 Federal St.
Pittsburg Office....Farmers' Bank Bldg.
Pacific Coast Agents
Otis & Squires
111 New Montgomery St., San Francisco

Wagner Electric

Manufacturing Company, St. Louis, Mo.

SLIP

in a polyphase motor is the loss in speed or lag of the armature behind the revolving magnetic field. The slip will increase with the load and be approximately proportional thereto.



Wagner 30-H. P., 1,140 R. P. M., 220-V., 3-Phase, 60-Cycle Motor

POWER

is the product of torque and speed. By reason of the greater slip incident to increased torque, the latter will not be accompanied by proportional increase in POWER. Wagner overload guarantees, however, are always given in power—not in torque. Please bear this in mind when making comparisons.

Correspondence invited. Please address the nearest office.

Atlanta, Ga., Empire Bldg.
Boston, Mass., 110 State St.
Chicago, Ill., Marquette Bldg.
Cincinnati, O., First National Bank Bldg.
Cleveland, O., New England Bldg.
Denver, Colo., 1621 17th St.
Kansas City, Mo., Dwight Bldg.
Los Angeles, Cal., 210 S. Los Angeles St.
Minneapolis, Minn., Security Bank Bldg.
New York, N. Y., 50 Church St.
Philadelphia, Pa., Real Estate Trust Bldg.
Pittsburg, Pa., Farmers' Bank Bldg.
Portland, Ore., McKay Bldg.
St Louis, Mo., 6400 Plymouth Ave.
San Francisco, Cal., Balboa Bldg.
Seattle, Wash., Pacific Block.
Sioux City, Ia., 515-517 5th St.
Montreal, Canada, Bell Telephone Bldg.

CONTRACTORS

TAKE NO CHANCES

The Celebrated Form L Motor, 1–20 to 5 H. P.

when they install **C-W** motors. They are protected by the guarantee that goes with each machine.

Bulletin 98 K contains data of value to all motor users.

CROCKER-WHEELER

COMPANY

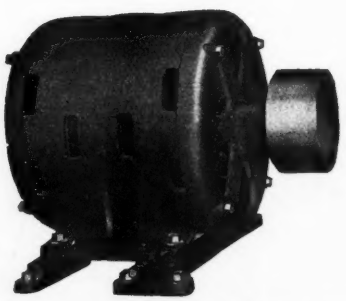
A.-C. AND D.-C. MACHINERY

WAREHOUSE IN CHICAGO

AMPERE, N. J.

WHEN IN DOUBT

INSTALL A

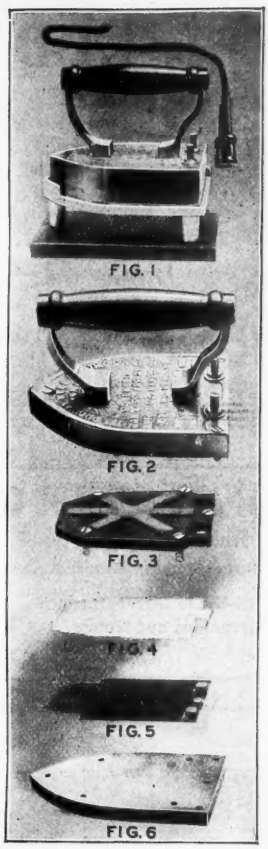


RICHMOND INDUCTION MOTOR

The Richmond Electric Company

Richmond, Va.

2



The Prometheus Electric Iron

BALD STATEMENTS TO THE EFFECT THAT AN ARTICLE IS THE BEST OF ITS KIND SHOULD CARRY LITTLE OR NO WEIGHT. THEY PROVE NOTHING.

HERE IS THE STORY OF THE "PROMETHEUS" IRON—A DRY STATEMENT OF FACTS—EXPLAINED AND SUBSTANTIATED BY THE CUT.

Fig. 1.—"PROMETHEUS" FIVE-POUND IRON (OUR BEST SELLER). Complete, with separable cord and Cast-iron Stand on Slate Base. The iron is fully nickel-plated. The stand is aluminum finish.

Fig. 2.—THE COVER. Attached to the bottom (Fig. 6) by three screws.

Fig. 3.—THE CAST IRON BALLAST PLATE. Attached to the bottom (Fig. 6) by five screws. It holds the Heating Element in place and adds weight to the iron.

Fig. 4.—ASBESTOS MAT. Aids in the even distribution of weight on the Heating Element and helps to confine the heat to the bottom.

Fig. 5.—THE "PROMETHEUS" HEATING ELEMENT. The vital part of the iron. The close contact between the Heating Element and the bottom—the working part of the iron—insures the quickest possible transmission of heat and high efficiency without the necessity of excessive heat in the Heating Element. This means economy in current consumption and durability of the element. All parts of the bottom are heated uniformly and the heat is transmitted to the bottom only. Cover and handle remain cool.

This Heating Element weighs but a few ounces and can be sent by mail. All that is needed to renew a "Prometheus" Iron are a new Heating Element and a screwdriver. The mode of operation is explained by the cut.

Fig. 6.—THE BOTTOM PLATE. The highly polished working end of the iron.

Our irons have stood the test of time on account of their unsurpassed simplicity of construction, high efficiency and great durability. The prices are the lowest possible for a high-class product.

Electric Flatirons will be a live issue for central stations and dealers in 1909. We are now booking orders for quantity lots.

WRITE US FOR PRICES TODAY

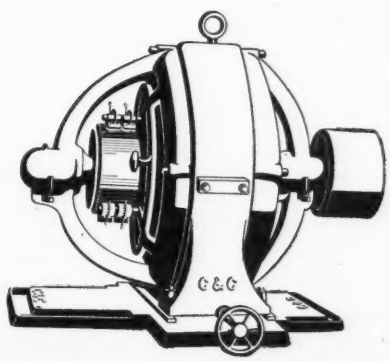
THE PROMETHEUS ELECTRIC COMPANY

234 East 43d St. **NEW YORK**

C & C Apparatus breeds confidence

Because:

From the start the purchaser is protected by our guarantee—the strongest, broadest, most liberal guarantee ever made in electrical apparatus. We couldn't make it if our apparatus weren't so good.



Because:

C & C apparatus is the coolest running on the market.

Its strong and correct construction and design make it exceptionally reliable.

It is unsurpassed in efficiency.

And—well, get the C & C bulletins and see.

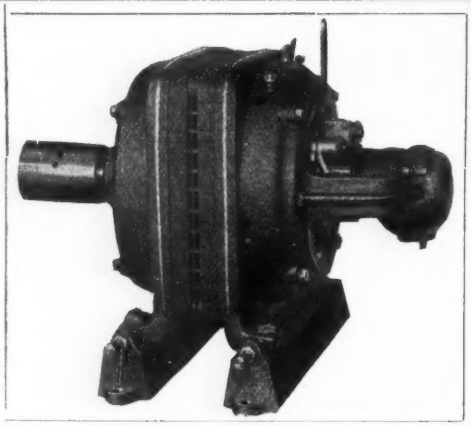
C&C

THE ELECTRIC CO.

Works and General Offices, Garwood, N. J.

New York Office, 149 Broadway **Philadelphia Offices, West End Trust Building** **Boston Offices, H. A. Howard, 115 Purchase Street**

AGENCIES IN ALL PRINCIPAL CITIES



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SINGLE-PHASE A. C. MOTORS

represent the highest excellence attained in the art of making variable-speed A. C. Motors.

Variable-speed and Reversible A. C. Power Motor.
½ h.p., $80.00; ¾ h.p., $95.00; 1 h.p., $105.00;
1½ h.p., $125.00; 2 h.p., $140.00.

WE ARE PIONEERS IN THE FIELD AND ORIGINATORS OF THIS TYPE OF MOTOR. WE LEAD, OTHERS FOLLOW.

No compensating devices. No starting coils. Join two wires — they connect — and the power is where you want it!

Our Motors are Guaranteed for Two Years

KIMBLE ELECTRIC CO.
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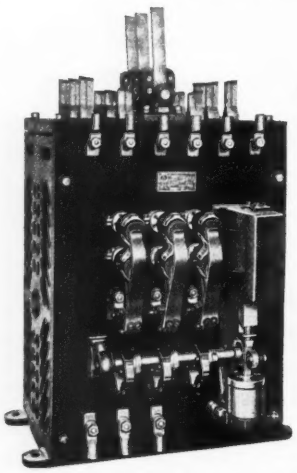
ELEVATOR CONTROLLERS
FOR A. C. MOTORS



15 H. P., 220 V., Type "A. S. F." Elevator Controller for Slip Ring Type Motor, Hand Cable Control.

ARE THE
SAFEST

Because the Rheostats are operated by solenoids and possess the

NO-VOLTAGE RELEASE FEATURE

Write for our new bulletins on A. C. self-starters and elevator controllers embodying this feature.

The result of 14 years' specializing in automatic motor control.

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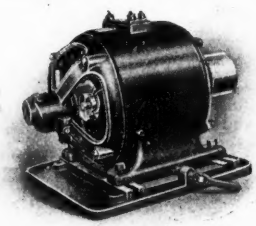

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High-Grade Direct-Current Dynamos and Motors.

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High-Grade Machine Work of all kinds. Correspondence Solicited

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1-40 to 1-2-h. p., single-phase; 1-20 to 2-h. p., direct-current, multiphase motors up to 1 h. p. A hundred different types regularly in stock. We make motors for every service. Special types developed. Motors for sewing machines, washing machines, motor-driven forge blowers exhausters, motor lathes. Write for Bulletins. Prices to the Trade only.

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TRIUMPH
MOTOR-DRIVING 4-SPINDLE DRILL

Bulletin ER 271

TRIUMPH ELECTRIC CO.
CINCINNATI, OHIO

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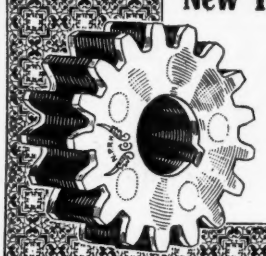
made possible by the use of
New Process Noiseless Pinions



They will mesh accurately with your old metal gears, wear like iron, reduce vibration, eliminate noise.

The Ideal Motor Drive

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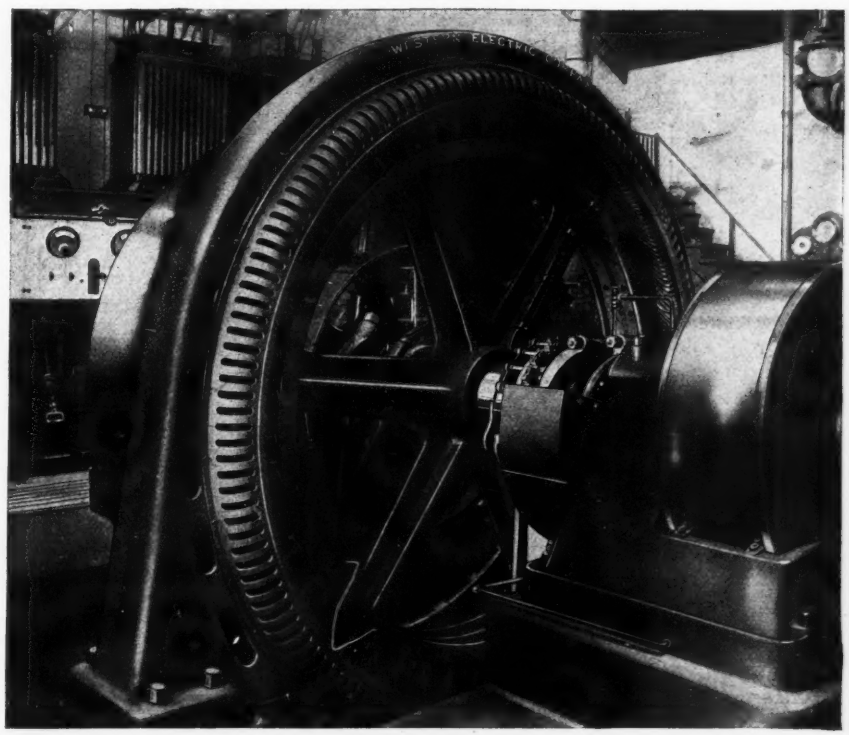
Syracuse, N. Y.

Every Detail and Every Process

used in the construction of Western Electric Alternators is given the most expert attention and careful inspection.

All raw materials are given a rigid test in the laboratories and those that do not come up to the specifications are rejected.



During the manufacturing processes in the shop every completed part is given a rigid test.

After completion each machine is given a thorough test to insure that its operation, both electrically and mechanically, is as guaranteed.

The result is shown in their unexcelled service record.

Send for Bulletin No. 306

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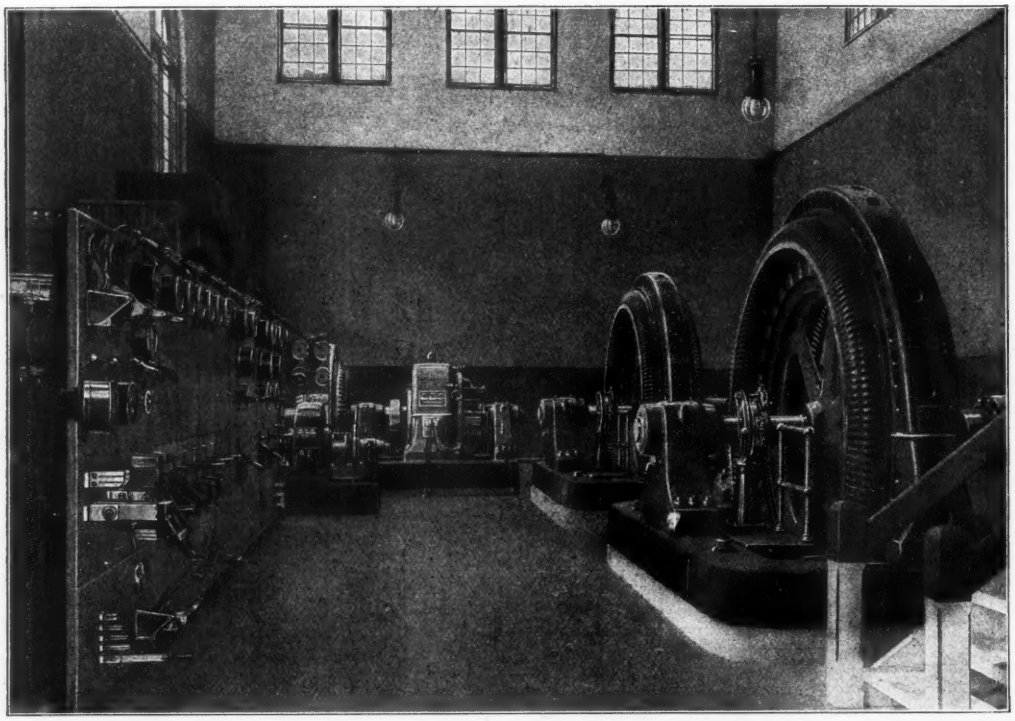
ELECTRICAL MACHINERY

This Company Can Furnish Whatever You Need in All Standard Sizes, for Either Direct or Alternating Current



Scene in the power plant of an electrically-operated pulp and paper mill, for which Allis-Chalmers Co. built the complete Electrical equipment.

Allis-Chalmers Company builds complete Power and Electrical Equipments for Mill, Factory or Central-Station Service, including any type of Prime Mover required—Steam Engine, Steam Turbine, Gas Engine or Hydraulic Turbine—Condensers, Pumps of every description, Generators for direct or alternating current, Transformers, Converters, Motor-Generator Sets and all Auxiliary Apparatus.

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DALLAS, Texas, Wilson Bldg.
DEADWOOD, S. D.
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PITTSBURG, Pa., Frick Bldg.
PORTLAND, Ore., 94 First St.
ST. LOUIS, Mo., 3d Nat'l Bank Bldg.
SALT LAKE CITY, Utah, Dooly Bldg., 117-119 West 2d South St.
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Canadian Representatives, Allis-Chalmers-Bullock, Ltd., Montreal.

"Columbia" Enclosed Arc Carbons have a beveled end which facilitates trimming.

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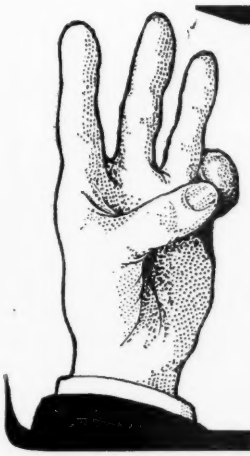

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EXCELLO FLAMING ARCS

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ECONOMY — DURABILITY — RELIABILITY

ECONOMY means an advantage over your competitor who pays more for light than you do.
DURABILITY means economy in maintenance.
RELIABILITY is sometimes the greatest consideration where the output runs into many hundreds of dollars per hou
If you are studying the problem of illumination, send for our new bulletins. They will sho w you the cost lighting per square foot and how many dollars you can save by installing Excellos.

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PANEL CIRCUITS

MAKE YOUR OWN PANEL BOARDS

WE WILL FURNISH PARTS AND CIRCUITS, WITH OR WITHOUT SWITCHES, FOR N. E. C. PLUG OR OPEN LINK FUSES. COMPLETE WITH LUGS, NUTS AND WASHERS, AND BUS-BARS IN STANDARD SIZES

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FOR
Manufacturing Plants
ON THE
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No. 1 Park Row, CHICAGO, ILL.

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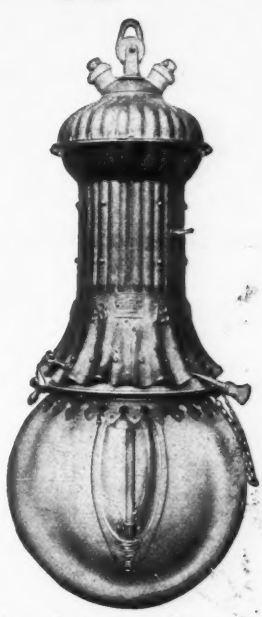

of any article does not guarantee its merit. Facts are what the publie desire. Here is our short story:

A.-B. ARC LAMPS are used by the largest central stations and private plants in this country. WHY?

Write for bulletins, prices and information.

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(1)

PHOENIX GLOBES

Of "Phoenix Quality"

10-157

"Phoenix" Globes for Tungsten Lamps

Photometric tests have proven that the "Phoenix" Globes for Tungsten lamps produce distinct illuminating results, bringing forth the full light-giving power of the lamp, so often obscured by inferior globes. This faculty of increasing capacity makes the "Phoenix" unique among Tungsten Globes.

"Phoenix Quality" in an inner globe means a higher quality than has been hitherto attained in globe manufacture. This globe will not blacken or crack under heat-strain. Not subject to softening and melting. Its clear, white light is of unfailing brilliancy.

5817

"Phoenix Quality" Outer Globes

Better tempered and hence more enduring than the average outer globe, they offer opportunity for real economy. Buying "Phoenix" you save expenditures for future renewals.

9552

Phoenix Quality Globes

For Ordinary Use

These globes are intended to fill the widespread demand for an improved everyday service globe for use on all types of incandescent lamps.

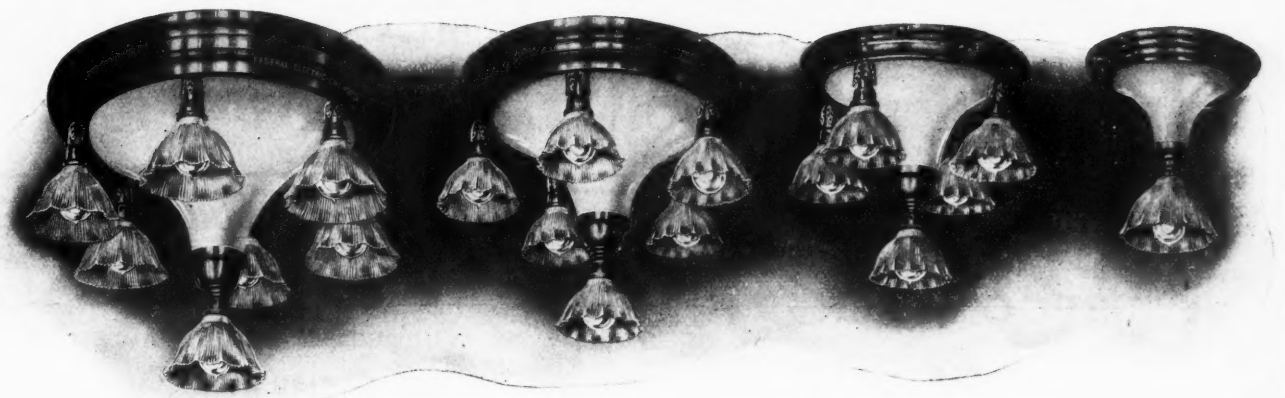
Write for Complete Catalogs

THE PHOENIX GLASS COMPANY

NEW YORK PITTSBURG CHICAGO

Artistic Federal Fixtures

For use with Tungsten Lamps



No. 501. Clusters. Made in four different sizes. Diameters, 15 to 30 inches, using from 1 to 11 lights.

Especialy adapted to fine interiors, large halls, stores, cafes—where ornamental fixtures are desired.

Federal Fixtures

For use with Large Tungsten Units

No. 560. 2-Light Fixture. Lamps up to 100 watts.

No. 600. Substantial Unit Fixture. Lamps up to 250 watts.

No. 603. Chain Unit Fixture. Lamps up to 100 watts.

Send for our Bulletin No. 987. It illustrates dozens of new Federal Clusters, with prices and discounts. Well worth inspection. Write today.

Federal Electric Company

Lake and Desplaines Sts., Chicago

See our exhibit at the Electrical Show, Coliseum, Chicago, January 16-30, 1909.

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Branch Offices: New York, Minneapolis, Cincinnati, Denver, Oakland

IF IT'S AN INCANDESCENT LAMP WE MAKE IT

Bryan-Marsh Tungsten Lamps are the Best

"NOTICE" ELECTRIC SUPPLY DEALERS, CONTRACTORS AND CENTRAL STATIONS. All Interested in the

NEW RECO FLASHERS

Should know about this apparatus. It's the simplest, strongest and most durable Sign Flasher on the market. Will produce any desired flashing effect. The Reco is free from all troublesome parts. *Write to-day for particulars and prices.*

REYNOLDS ELECTRIC FLASHER MFG. CO., 192 Fifth Avenue, CHICAGO

INE ELECTRIC SIGNS and LASHING EFFECTS

URNISHED AND INSTALLED BY

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"JOBBERS' LAMP COMPANY"

Mr. Jobber, Dealer or Contractor, ask us WHAT THAT MEANS!

GENERAL INCANDESCENT LAMP CO. - Cleveland, O

We are Specialists in the Manufacture of

TUNGSTEN Miniature, Low Voltage and Automobile LAMPS

Write for ILLUSTRATED CATALOGUE and Price List

ALSO TELEPHONE SWITCHBOARD LAMPS

The Sterling Electrical Mfg. Co., Warren, Ohio

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Electrical Review and Western Electrician's

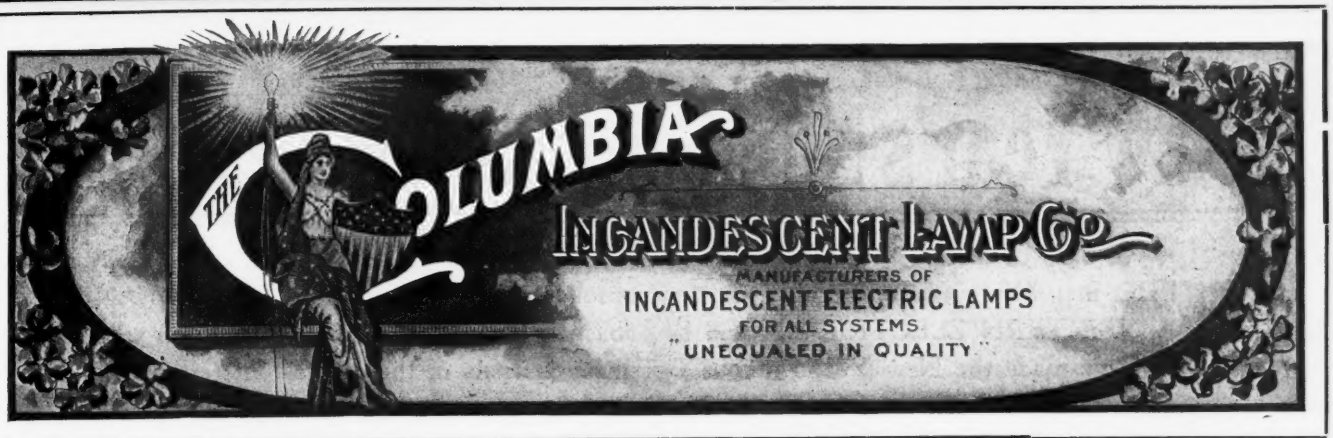
Moonlight Schedule

For 1909

10 CENTS PER COPY

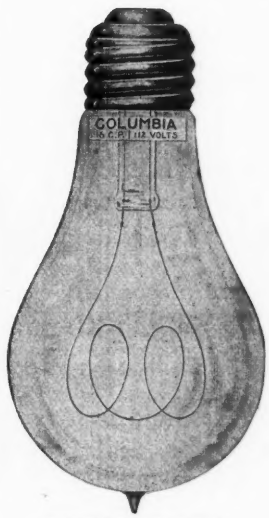
ELECTRICAL REVIEW PUBLISHING CO.

507 Marquette Building, Chicago



COLUMBIA LAMPS

The culmination of 19 years of study and experiment in the science of incandescent lamp making. Experience counts.



REGULAR COLUMBIA

Fifty per cent more light through the tip than other types without increased current consumption.

COLUMBIA TANTALUM

20 C. P. 40 watts
40 C. P. 80 watts

COLUMBIA 30-WATT 20 C. P. GEM

Operating at 2½ watts per C. P efficiency.
Also—16 C. P. 40 watts
32 C. P. 80 watts

COLUMBIA TUNGSTEN

Type	Stand. Pkg., Quant.
25 Watt	100
40 "	50
60 "	50
00 "	24

TUNGSTEN MERIDIAN

40 watt, 3¾ in. round bulb
60 " 5 " " "

A LINE
NOT TO BE MATCHED

The lamps herewith illustrated are sold under a positive guarantee covering uniformity, candle-power maintenance and every other essential of lamp service.

Prompt Shipments. Write for Special Proposition. Order now.

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BOSTON, 170 Purchase Street
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SAN FRANCISCO, 111 New Montgomery Street

LOOK FOR THE LICENSE LABEL

New Year's Number, January 2, 1909

THE first New Year's Number of the consolidated ELECTRICAL REVIEW AND WESTERN ELECTRICIAN will be published January 2, 1909. The features which have made the New Year's numbers of these journals of the greatest interest and importance will be maintained, and the achievements of former years will be surpassed.

SPECIAL FEATURES

The contributions in this New Year's Number will include:

The Annual Review of the Year's Electrical Developments. This will comprise a summary of the progress made in pure and applied electrical science.

A carefully compiled Annual Table of Statistics of the extent and value of electrical and kindred apparatus manufactured in the United States in 1908.

Specific information dealing with progress in Central-Station Practice, Street and Interurban Electric Railroading, the Electrification of Trunk Line Railroads, Telegraphy and Telephony—with and without wires, the development of the newer forms of Arc and Incandescent Lighting.

Reviews of the Year's Electrical Progress in Great Britain and on the Continent, especially compiled by staff correspondents of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN.

In addition to all this special material, there will be the usual editorial features and technical contributions dealing with contemporary applications, a finely illustrated section dealing with new installations, a comprehensive digest of current engineering literature, a section devoted to the latest offerings of the manufacturers of electrical and allied apparatus, and a News Section, bringing to the reader the Advance Information—under careful classification—of the possibilities of the utilization of electrical construction material of every nature.

All persons contemplating subscribing should send their orders in at once so as to receive this unusually interesting and valuable New Year's Number.

Every advertiser who desires to reach the entire electrical industry should be strongly represented in the advertising pages of this New Year's Number. The permanent value of these numbers is recognized. This fact, together with the recent consolidation of these two great electrical journals, makes the issue of January 2, 1909, of unique importance and value.

The demand for advertising space already indicated is unusually heavy, and early reservations are recommended.

Electrical Review and Western Electrician

MARQUETTE BUILDING, 204 DEARBORN STREET

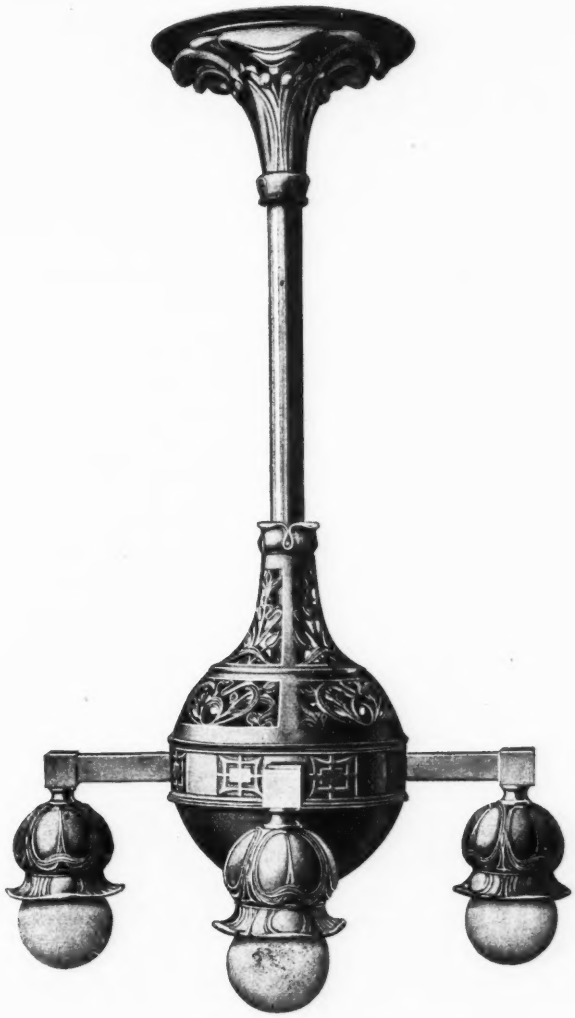
NEW YORK
13 Park Row

CHICAGO

LONDON
42 Old Broad St., E. C.

The New Westinghouse Nernst Chandeliers

"Absolutely unique in the field of lighting devices."



Art Nouveau Design

¶ Give more light for the space occupied by the light sources than has ever before been possible in incandescent chandelier lighting. Equipped with the new screw base burners.

¶ Made in two artistic and graceful designs: Art Nouveau and Renaissance; statuary bronze and satin brass finishes. Made with two, four and six arms. Combination gas and electric chandeliers to match.

The 6-light, 110-watt chandelier (total, 660 watts) gives, on account of its high efficiency, the greatest amount of light per outlet available in incandescent chandelier lighting.

Send for advance Bulletin.

NERNST LAMP COMPANY

PITTSBURG, PA.

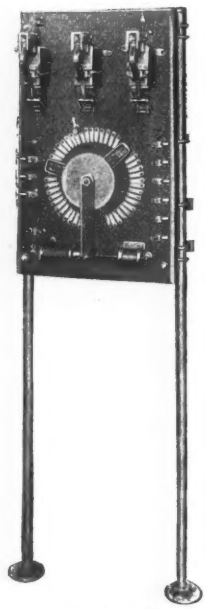
DISTRICT OFFICES IN PRINCIPAL CITIES

General Electric Company

Automatic Starters

For Polyphase Induction Motors

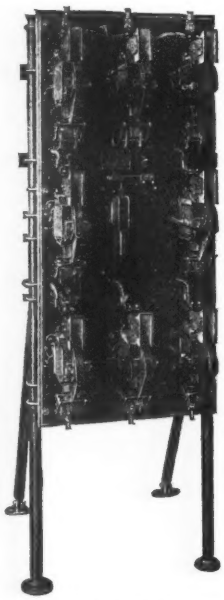
A complete line of automatic starters for low and high voltage polyphase induction motors of both the slip-ring and squirrel-cage type—especially adapted to operate motors driving pumps, air compressors, etc.



Starter for Slip-Ring Type of Motor

Slip-Ring Type—CR-128

Automatic starters of this type insert resistance in the rotor winding by means of a three-phase ratchet-driven dial switch. The line circuit is open and closed by three alternating current contactors equipped with magnetic blow-outs, as shown in the illustration. For motors of ordinary size the current carried by the dial switch is so small that there is no burning or pitting of the contacts. For larger motors the dial switch is connected to act as a master controller. In this case the heavy rotor current is carried by contactors.



Starter for Squirrel-Cage Type of Motor

Squirrel-Cage Type—CR-126

Automatic starters of this type make use of the compensator method of starting. Instead of taking several times normal load current in starting, as is the case when resistance is used, this method keeps the line current smaller than the motor current, thus preventing serious disturbance of line voltage.

In the type of starter illustrated, both line and motor current is broken by quick-acting alternating current contactors, equipped with magnetic blow-outs which quickly rupture the arc. These magnetic blow-out contactors are a decided improvement over the sliding contact type of switch usually used with starters for squirrel-cage type of motors. In this latter type the heavy currents carried by the sliding switch generally result in the contacts being burned and roughened.

For further information write to nearest local office

1958

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OF ALL CLASSES OF

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Boston Renewed Lamps

4 to 16 c. p.—100 to 130 volts—in not less than standard package quantities, f. o. b. Danvers.

NINE CENTS EACH

Best Quality Guaranteed **Discounts to Dealers**

Other voltages and candlepowers at correspondingly low prices.

Order now. We can deliver promptly

Boston Incandescent Lamp Co.

DANVERS, MASS.

The New WESTON
Alternating-Current Switchboard Ammeters and Voltmeters

will be found vastly superior in ACCURACY, DURABILITY and WORKMANSHIP to any other instruments intended for the same service

They are

Absolutely Dead Beat,
Extremely Sensitive,
Practically Free from Temperature Error.

Their indications are

Practically Independent of Frequency and also of Wave Form. They require *Extremely Little Power for Operation,* and are *Very Low in Price.*

Correspondence concerning these new Weston Instruments is solicited by the

WESTON ELECTRICAL INSTRUMENT COMPANY, WAVERLY PARK NEWARK, N. J.

London Branch: Audrey House, Ely Place, Holborn.
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Berlin: European Weston Electrical Instrument Co., Ritterstrasse, No. 88.

NEW YORK OFFICE, 74 Cortlandt Street
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National Code

P & S No. 3000

Each and every P & S No. 3000 Pendant Switch is covered by the P & S guarantee to fully perform all its proper functions.

PASS & SEYMOUR - INC.
MFRS. OF ELECTRICAL SPECIALTIES AND PORCELAIN OF SPECIAL DESIGN
SOLVAY, N.Y. U.S.A.
NEW YORK CHICAGO
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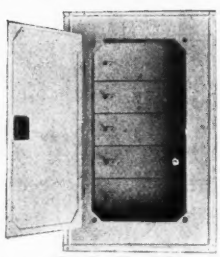
Sectional Iron Panel Boxes


Catalog No. 4162

have so many good points tied up in the one thing, it will pay you to look into their make-up and price. We make all kinds and sizes for Panel Cut-outs, Plug Cut-outs and Panelettes. Our monthly bulletin, "Paistery," tells all about the new good things. Do you get it? Let us know.

H. T. PAISTE CO., Philadelphia, Pa.
(2) New York Boston Chicago

MANY MILLIONS OF DOLLARS' WORTH

of Electrical Machinery, Apparatus and Supplies are inspected and tested by us every year for the shrewdest buyers in America

They DEMAND the best—and they GET it

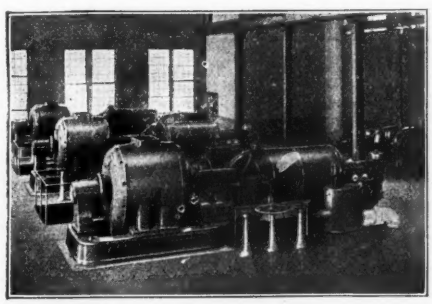
Our Facilities are at Your Service

Don't Fail to See Our Exhibit in the Fourth Annual Electrical Show, Coliseum, Chicago, Jan. 16-30, 1909

Electrical Testing Laboratories 80th Street and East End Ave. NEW YORK

Allis - Chalmers Steam Turbines Used in Many Lines of Industry.

While the importance of the steam turbine as a prime mover in power plants for street railway and lighting systems was long since recognized, it is only very recently that this machine has entered what is popularly known as the "industrial" field, the reason being that the owners of factories, mills and other establishments of a similar character have not, hitherto, regarded the steam turbine as either economical or sufficiently reliable for their purpose. With the advent of the improved type of machine now built in this country by Allis-Chalmers Company, of Milwaukee, the situation is, however, rapidly changing, because of the fact that practical demonstration has already been made of the continuous efficiency and reliability of this turbine under the most severe conditions of service, whether in power station, lighting plant, steel works, factory, ore reduction plant, shops or mill.



Three of Four Allis-Chalmers Steam Turbines and Generators, 5,500 K. W. Capacity, in a Textile Mill.

Considerable comment has, of late, been made in the trade and technical press on the leading part played in the electrification of textile plants in various parts of the country, particularly in New England, by steam turbines and generators of Allis-Chalmers Company's build, including four units for the new 10,000 horsepower plant of the Pacific Mills, Lawrence, Mass., one of 2,200 horsepower for the American Thread Company's Watuppa mills and two of 4,000 horsepower for their Kerr Mills, one of 3,000 horsepower for the Tremont and Suffolk mills, machines of 750 horsepower each for the Jamestown Worsted Mills and Cherry Cotton Mills, a unit of 1,000 horsepower to be installed in the plant of the Lawton Spinning Company, Woonsocket, R. I., and another of 3,000 horsepower for the Clark Thread Company, Newark, N. J.

Two of these units, with a normal rating of 3,000 horsepower, are in service in the power plant of the Illinois Steel Company's works at South Chicago, where after one of the quickest installations on record, the heavy fluctuating load incident to rolling mills was thrown upon the machines and maintained constantly ever since in twenty-four hours service. No more severe test than this is ever imposed upon a prime mover of any type in regular operation. The Youngstown Sheet Tube Company has followed the example of the Illinois Steel Company by ordering two units of 4,000 horsepower to carry the heavy load at its plant in Youngstown, Ohio.

Similar to the service in steel plants and equally "hazardous" from the point of view formerly held, before the improved type of turbine was perfected, is the work of a cement mill. Not long ago the idea of installing steam turbines to furnish power would have been regarded by cement manufacturers as preposterous; but, some months since, an American concern, the Helderberg Cement Company, of Howes Cave, N. Y., led the way by purchasing an Allis-Chalmers unit of 2,000 horsepower capacity, and the Western Canada Company followed with an order for three turbines and generators of 6,000 horsepower, normal rating, to operate its extensive works near Calgary.

A company of interests widely diversified from those above mentioned is the Celluloid Company, manufacturing celluloid specialties of all kinds in a large plant at Newark, N. J. Here there have been installed two units of 2,250 horsepower capacity to furnish power for operating the factory, which is said to be one of the best equipped in the country.

A saw mill would hardly occur to the uninitiated as the proper place for a steam turbine, but the Savannah Lumber Company, a large manufacturer of dressed timber at Savannah, Ga., placed an Allis-Chalmers unit of 750 horsepower in its plant and soon followed this installation with an order for another machine of the same size. A duplicate of these has also been installed by the Salsich Lumber Company, McKenna, Wash.

Down in the mountains of Old Mexico is the Lluvia de Oro mine, one of the richest in the world, and thither a turbine unit has been sent, while others have gone to the Calumet and Arizona ore reduction works at Bisbee, Ariz., and to the Bisbee Improvement Company, of the same place, to furnish current for lighting and the operation of motors at various plants in the vicinity.

For its collieries near Scranton, Pa., which are noted the world over for their up-to-date machinery, the Delaware, Lackawanna & Western Railway Company has provided an Allis-Chalmers steam turbine and generator of 3,000 horsepower capacity, and not far from these workings twinkle the lights supplied by current from a unit of 2,000 horsepower recently installed by the American Gas & Electric Company in its Scranton plant.

In Milwaukee, the Public Service Station, built by John I. Beggs, has three turbines of 6,000 horsepower capacity, which are run non-condensing, the exhaust steam being distributed for heating purposes through underground tunnels to buildings in the business districts. Two of that city's tanneries, Pfister & Vogel Leather Company and A. F. Gallun & Sons, are also installing units of 6,000 horsepower aggregate capacity.

In the manufacture of high-grade floor covering the Nairn Linoleum Company uses an Allis-Chalmers steam turbine generating unit of 750 horsepower to furnish electric power for operating its factory at Kearny, N. J., and other plants of the vicinity are interested in this type of prime mover.

At Dayton, Ohio, the National Cash Register Company has provided a unit of 1,500 horsepower to furnish power for the recent extension to its well-equipped shops.

From turbines and generators ranging in capacity from 750 to 10,000 horsepower installed by the Brooklyn Edison Company; Kings County (N. Y.) Electric Company; Binghamton, N. Y., Light, Heat & Power Company; Brush Electric Light & Power Company, of Galveston, Texas; Citizens' Light, Heat & Power Company, of Johnstown, Pa.; Dayton Lighting Company, Dayton, Ohio; Northampton, Mass., Light, Heat & Power Corporation; Madison, Wis., Gas & Electric Company; Memphis, Tenn., Consolidated Lighting & Power Company; Flatbush Gas Company, of Brooklyn, N. Y.; Meriden Electric Company, Meriden, Conn.; Dan River Power & Manufacturing Company; New York Edison Company; Utica Gas & Electric Company; Westchester Lighting Company; New Rochelle, N. Y., Western United Gas & Electric Company; Aurora, Ill., Pennsylvania Power Company; Willamette Valley Company, all of which are of Allis-Chalmers Company's build, will be supplied current for lighting many manufacturing establishments and operating motors used in a great variety of industries. Some of the units were installed on "repeat" orders and represent largely increased service to customers in their vicinity.

Municipal plants at Columbus, Ohio; Jacksonville, Fla.; Dunkirk, N. Y.; Holland, Mich.; Frankfort, Ind.; Austin, Texas; Danville, Va., Nashville, Tenn., and Bay City, Mich., have these turbines installed or on order, and traction companies operating out of Wilmington, Del.; Cedar Rapids, Iowa; Indianapolis, Ind.; Homer, Pa.; Kokomo, Ind.; Warsaw, Ind.; Athens, Ga.; Cleveland, Ohio; Pueblo, Colo., and Richmond, Va., all of which furnish power for use in their own building and repair shops, and others adjacent to them, use Allis-Chalmers turbine units for generating their current.

From the above it will be seen what a measure of importance attaches to the fact that a turbine has, at length, been placed upon the market which can be completely depended upon in power service for manufacturing plants of any description where electric current can be used to advantage. That this is due entirely to recent improvements in design, such as plainly obviate all danger of stripping, distortion, unbalancing and other defects inherent in earlier types, cannot be denied, and hence the purchaser has every assurance of the continuous reliability of these units in regular industrial operation.—*Wool and Cotton Reporter.*

POSITIONS WANTED

The rate for "Positions Wanted" advertisements of forty words or less is one dollar an insertion; additional words two cents each, payable in advance. Remittances and copy should reach this office not later than Monday, 12 o'clock noon, for the next succeeding issue.

Replies may be sent in care of Electrical Review and Western Electrician, 507 Marquette Building, Chicago, or 13-21 Park Row, New York.

POSITION WANTED—As chief engineer in electric-lighting and power plant up to 5,000 horsepower, or superintendent of smaller plant; can refer to the best men in the steam and mechanical engineering field; 36 years old, married; don't drink; steam turbine experience; a money saver and can prove it. Wm. Westerfield, Box 764, Lincoln, Neb.

POSITION WANTED—Eastern engineer, broad American and extensive up-to-date European experience, particularly well posted in modern hydraulic developments, steam-power plants, electric transmission and traction, power and factory economics, desires to associate with western concern. A1 references. Address Box 1014, care of Electrical Review and Western Electrician, 507 Marquette Bldg., Chicago.

HELP WANTED

The rate for "Help Wanted" advertisements of forty words or less is one dollar and fifty cents an insertion; additional words three cents each, payable in advance. Remittances and copy should reach this office not later than Monday, 12 o'clock noon, for the next succeeding issue.

Replies may be sent in care of Electrical Review and Western Electrician, 507 Marquette Building, Chicago, or 13-21 Park Row, New York.

WANTED—A large electrical manufacturing company requires a capable, experienced foreman for its indicating-instrument department; previous experience indispensable. Apply, giving experience and salary expected; all communications confidential. Address Box 1020, care of Electrical Review and Western Electrician, Chicago.

WANTED—Salesmen regularly visiting central stations to handle important side line on commission, selling from cuts. Exclusive territory for energetic and competent men. State experience, territory traveled and other lines represented. Address No. 1030, care of Electrical Review and Western Electrician, Chicago.

WANTED

50 Cts. per Stick. $5.00 per Dozen
For Sale by all Supply Houses, or
FREE, Sample Stick

You who are Troubled with Sparking and Cutting of Commutators to Use
The only article that will Prevent Sparking. Will keep the commutator in good condition and Prevent Cutting.
Absolutely Will Not Gum the Brushes.
It will put that high gloss on the commutator you have so long sought after.
K. McLENNAN & CO.
Sole Manufacturers
Room 411, Inter Ocean Bldg.,
130 Dearborn St., Chicago, Ill.

Peirce Steel Brackets
Peirce Expansion Bolts
Peirce Hammer Drill
PEIRCE SPECIALTY COMPANY
ELKHART, INDIANA.

LAMP COLORING
AND
WEATHERPROOF COLORING
The Electric Motor & Equipment Co.
Newark, N. J.

SAVE MONEY IN BELTING

QUALITY is remembered after PRICE is forgotten—we stick to selling Sable Belting because a **Sable Belt will transmit 25 to 33 per cent more power than any oak tanned belt.**

To prove it we will send one on 30 days' trial. If it is not all we claim, it may be returned at our expense. All shoes LOOK alike, but you still buy a $5.00 shoe although there are hundreds of brands of $3.00 shoes. Why? *Send for Booklet No. 42.*

SHULTZ BELTING CO., St. Louis, Mo.
NEW YORK BOSTON PHILADELPHIA

USE
Phelps Alloy-Platinum Substitute
FOR ELECTRICAL CONTACTS
Write for particulars
PHELPS MANUFACTURING COMPANY, - DETROIT, MICH.

POPULAR ELECTRICITY
in Plain English

CENTRAL-STATION MANAGERS—Every number of Popular Electricity explains to the people—your customers—way of doing things electrically, applications of electricity in the home, in the office, in the factory. You cannot imagine a more prolific form of advertising than to have this magazine in the home of everyone of your **customers** to show them where it will be to their advantage to use **more current.** Your prospective **customers** should read Popular Electricity. They will read of a hundred reasons why they should be **"on the Service."**

We have a plan whereby we can co-operate with you. Write us.

MANUFACTURERS AND DEALERS—Anything which interests the people in the use of electricity furthers the sale of your product. Your assistance will be valuable in building up our circulation. We want hustling representatives in your plant and in your town. Lend a hand to help a "game" which "boosts" yours.

ELECTRICAL WORKERS—Popular Electricity is not only interesting but keeps you posted on the latest developments in **all lines** of electrical development. While non-technical, many high-class engineers read it with interest. Electricians read it. Mechanics read it. Telephone men, Telegraphers, Linemen—all are enthusiastic.

Popular Electricity is issued monthly. One dollar per year; $1.50 in Canada and foreign countries.

Our regular offer to agents is very attractive, and as a little special inducement we are going to give five free trips to the Chicago Electrical Show. Write at once for particulars.

Popular Electricity Publishing Co.
Monadnock Block, Chicago

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DYNAMOS
MOTORS METERS
ARC LAMPS
TRANSFORMERS
ELECTRICAL SUPPLIES

We **rent Electrical Machinery.**

We **repair all makes** of **Electrical Apparatus.**

Send for our **latest** complete **bargain book** and **net prices.**

GUARANTEE ELECTRIC CO.
Adams and Clinton Sts., - - CHICAGO
EDWIN R. ROCKWELL, General Manager

DEARBORN WATER TREATMENT

Prepared always scientifically to meet requirements of each individual case, is essential to the successful and economical operation of every boiler room. Cost of treatment per thousand gallons **VERY LOW.** Gallon of water required for analysis.

DEARBORN DRUG & CHEMICAL WORKS

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Babcock & Wilcox, Stirling, A. & T. Horizontal, Oahall Vertical

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Steam Superheaters — Mechanical Stokers

WORKS: BAYONNE, N. J.; BARBERTON, OHIO

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CHICAGO, Marquette Building
ATLANTA, GA., Candler Building
CLEVELAND, New England Bldg.
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LOS ANGELES, Trust Building
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The

Niagara Hotel

American Plan, $3.00 a Day and upward.

Away from the city's noise and smoke.

The most comfortable hotel in Buffalo. Beautiful Palm Garden. Large, airy rooms, with Bath. Two blocks from Lake Erie and Niagara River. Niagara Falls electric cars one minute from the door.

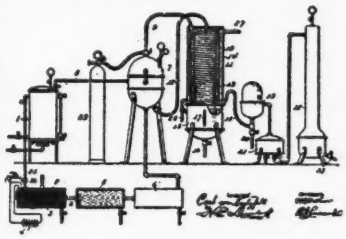
Wire at our expense, or write for reservations and carriage will meet you and take you to hotel free of charge. Six minutes from downtown.

Reduced rates to Tourists, Professional and Traveling Men.

Spaulding Hotel Co.

Mrs. C. J. SPAULDING, C. A. SPAULDING } Props.

PORTER AVE. AND 7TH ST.



Alcohol from Natural Gas Will Rival Gasoline for Light, Heat and Power.

A new industry that will rival gasoline is that of denatured alcohol for light, heat and power. Five thousand feet of natural gas costs 6 cents per 1,000 feet, containing 94 per cent of methane, will produce 50 gallons of alcohol; 5 gallons alcohol equals one cord of hardwood or one and three-tenths tons of soft coal in heat units. On the basis of 100 horsepower, 10 hours' run, one year, alcohol at 30 cents per gallon approximates $234; coal at $4 per ton, $3,400; the yearly saving equals 6 per cent on a capitalization of $65,000. We propose to your commercial club to establish a new industry, manufacturing alcohol from natural gas at low cost, employing from 10 to 45 men, according to the capacity of the plant. Alcohol is a necessity on land and sea. The automobile and the navies of the world use it; the market demands it. We are ready to negotiate for this new manufacturing industry in your locality. Will you allow us to come in?

If so, address THE CONTINENTAL NATURAL GAS ALCOHOL CO., WHEELING, W. VA.

FOR SALE

Steam Engines, Steam Pipes, Fittings and other Steam Equipment, Arc Lamps, Dynamos, Switchboards and Belting.

Sealed proposals will be received by the West Chicago Park Commissioners, Union Park, Chicago, on or before 4 o'clock p. m., December 22, 1908, for:

2 650-H. P. Cross Compound Corliss engines, complete, built by Filer & Stowell Mfg. Co.

Also steam pump, Nordberg surface condenser, jack shaft and friction clutches.

1 General Electric Company alternating-current dynamo, Type A. S., No. 1033, Class 8-90-900, Form A, amperes 39, volts 2,080-2,300, speed 900.

Also exciter, switchboard panel, belt, voltmeter and ammeter.

4 General Electric Company arc-light dynamos, Type 13A, 8,000 volts, 9.6 amperes, speed 500, oil regulators, base frames and tighteners.

2 Western Electric Company arc light dynamos, volts 7,500, 9.6 amperes, speed 600, 2 iron pulleys 33¾-inch diameter, 13-inch face, base frames and tighteners.

Also switchboards, ammeters and belts.

Approximately 800 Standard Boulevard type series open-arc focusing lamps, 9.6 amperes, ⅝x14-inch top carbon, ½x12-inch lower carbon, opal and alabaster globes, 4¾-inch bottom and 8-inch opening.

Approximately 100 Thomson-Houston double carbon series open-arc lamps, 9.6 amperes.

Bids must be made upon forms which may be obtained from the secretary of the West Chicago Park Commissioners, said forms giving more detailed and complete information.

A deposit of five (5%) per cent of the total amount of the proposal must be made with each bid, and the West Chicago Park Commissioners reserve the right to reject any or all bids.

GEORGE A. MUGLER, Secretary,
West Chicago Park Com., Union Park, Chicago

FOR SALE—SECOND-HAND

250-V. D. C. GENERATORS

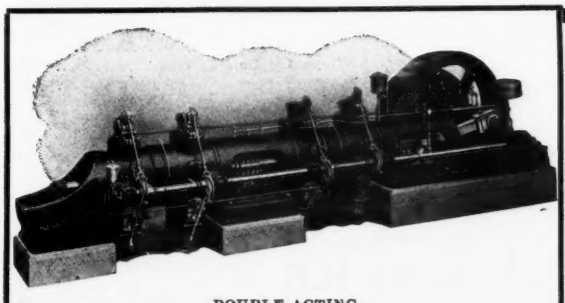
BARGAINS

	K.W.		Speed
1	12	C. & C., M. P., type S, comp.	1200
1	12	Siemens & Halske, M. P., comp.	1100
1	12½	Gen. Elec., M. P., form A, comp.	725
1	13½	Gen. Elec., M. P., form H, comp.	900
1	15	Siemens & Halske, M. P., comp.	1050
1	15	Western Elec., M. P., comp.	700
2	17½	Gen. Elec., M. P., comp.	1200
1	17½	Gen. Elec., M. P., comp.	750
1	18	Milwaukee, M. P., comp., direct connected to 7"x7" McEwen automatic engine	400
1	20	Jants & Leist, M. P., comp.	825
1	20	C. & C., M. P., comp., direct connected to 8"x10" Chandler-Taylor engine	320
1	30	C. & C., M. P., comp., direct connected to 9"x10" Chandler-Taylor engine	320
2	35	Western Elec., M. P.	475
1	35	Northern, M. P., comp., direct connected to Ideal latest type self-oiling engine, 11x10 (new)	290
1	50	Siemens & Halske, 6-pole, comp.	800
1	50	Northern, M. P., comp., direct connected to Ideal latest type self-oiling engine, 12x12 (new)	300
1	56½	Westinghouse, M. P., comp.	800
1	60	Milwaukee, 6-pole, comp.	550
1	60	Thresher, 6-pole, comp.	525
1	100	Card, M. P., comp.	575
1	100	Thompson-Ryan, 10-pole, comp., direct connected to 14"x14" self-oiling Allfree engine	275
1	125	Ft. Wayne Wood, 6-pole, comp.	700
1	150	Milwaukee, 6-pole, comp., 3-bearing	560

Every machine listed is actually in stock. Send for our Monthly Bargain Sheet, showing complete stock with net prices.

GREGORY ELECTRIC CO., CHICAGO

Established 1893.



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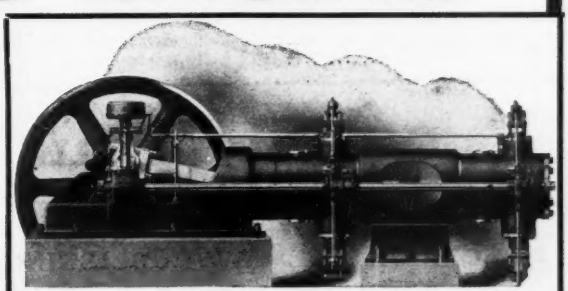
THE BUCKEYE 4-STROKE CYCLE GAS ENGINE

DOUBLE AND SINGLE ACTING

The highest type of HEAVY Duty engines on the market. Built in powers from 50 to 6,000 horses. Catalog on application.



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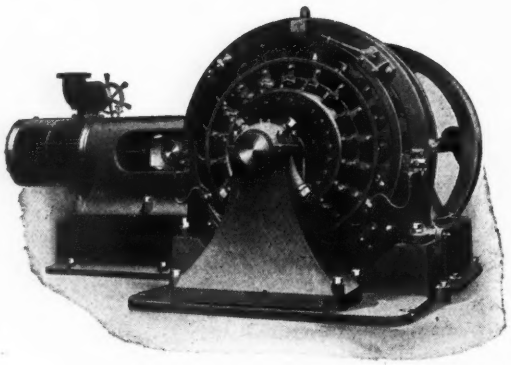

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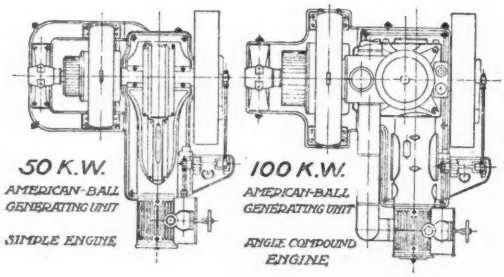

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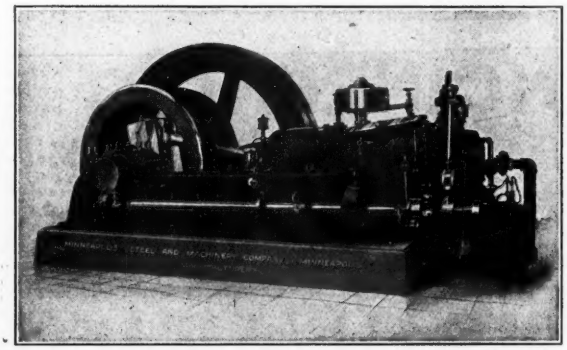

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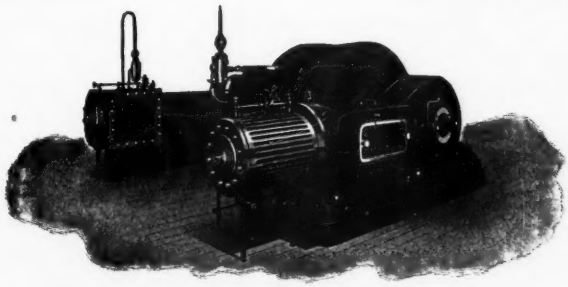

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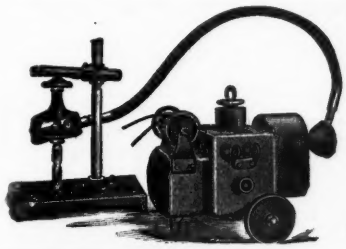

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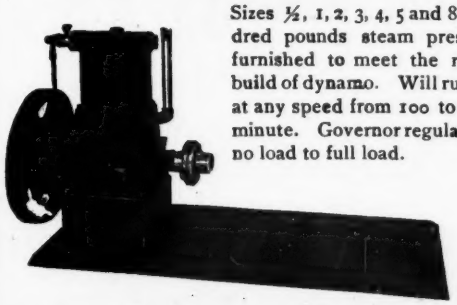

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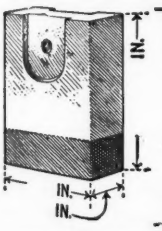

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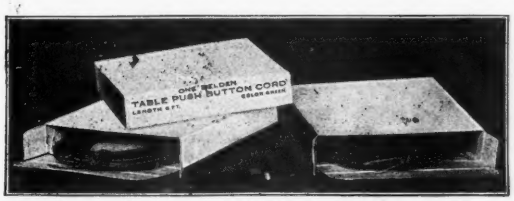

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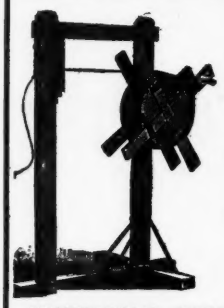

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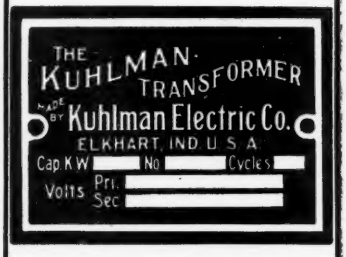

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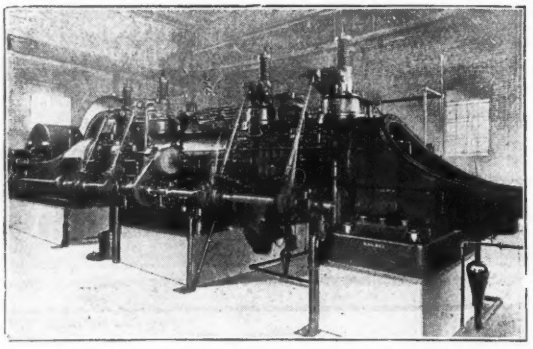

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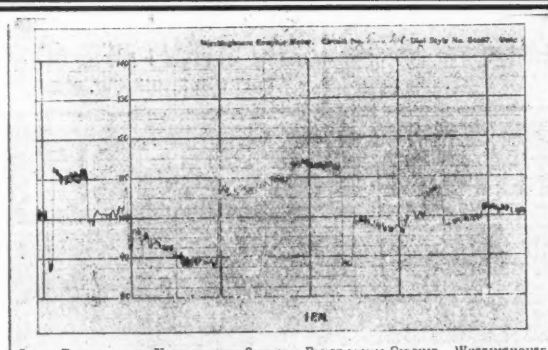

Chart Taken on the Unregulated Side of a Fluctuating Circuit. Westinghouse Graphic Recording Voltmeter used: Scale 2½ Volts Per Division; Rate of Feed, Eight Inches Per Hour

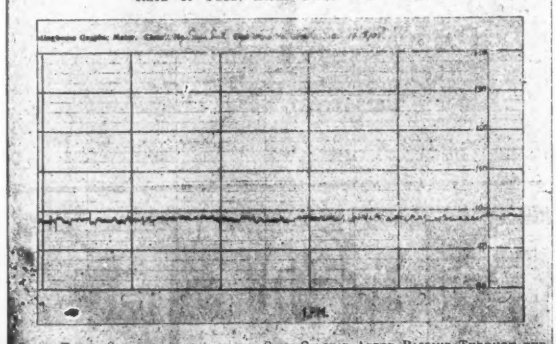

Chart Taken Simultaneously on the Same Circuit After Passing Through the Regulator. Voltage Regulating Relay Set for 98 Volts Normal Plus or Minus One-Half Volt, Sensibility Setting

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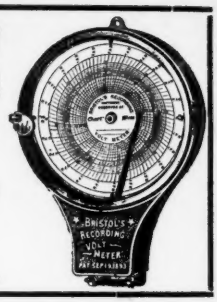

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